United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Iowa Agriculture and
Home Economics
Experiment Station;
Cooperative Extension
Service, Iowa State
University; and Division of
Soil Conservation, Iowa
Department of Agriculture
and Land Stewardship

Soil Survey of Montgomery County, Iowa

How To Use This Soil Survey

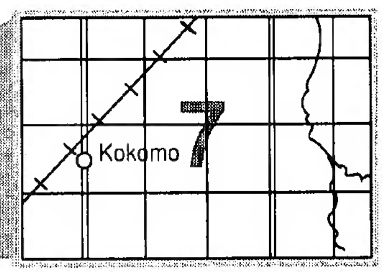
General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

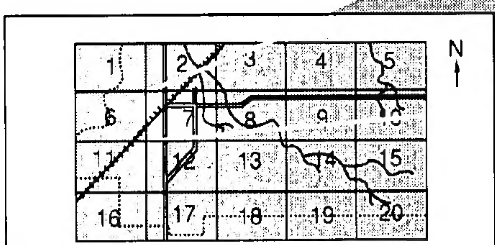
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.



MAP SHEET

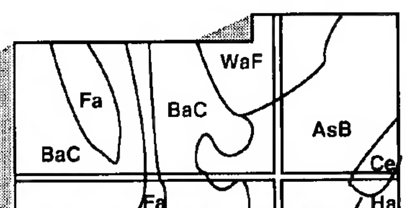
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.

MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1986. Soil names and descriptions were approved in 1987. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. This survey was made cooperatively by the Soil Conservation Service; the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship. It is part of the technical assistance furnished to the Montgomery County Soil Conservation District. Funds appropriated by Montgomery County were used to defray part of the cost of the survey.

Cover: Hayland in an area of the Marshall-Shelby association.

Contents

Issued September 1989

Index to Map Units

Summary of Tables

Preface

This soil survey contains information that can be used in land-planning programs in Montgomery County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Soil Survey of
Montgomery County, Iowa

By Bennie Clark, Jr., Soil Conservation Service

Fieldwork by Charles E. Branham, Bennie Clark, Jr., and Jonathan W. Hempel, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship

MONTGOMERY COUNTY is in the southwestern part of Iowa (fig. 1). It has an area of 270,080 acres, or 422 square miles. Red Oak, the county seat, is in the central part of the county, about 125 miles southwest of Des Moines, the state capital.

The county is chiefly agricultural. The principal crops are corn, soybeans, oats, hay, and pasture. Corn and soybeans are the most important crops sold, although some of the corn is fed to livestock. Beef cattle and hogs are also a principal source of income.

The principal streams in the county are the East Nishnabotna River, West and Middle Nodaway Rivers, and Walnut, Tarkio, and Indian Creeks.

This survey updates the soil survey of Montgomery County published in 1917 *(9)*. It provides additional information and contains larger maps that show the soils in more detail.

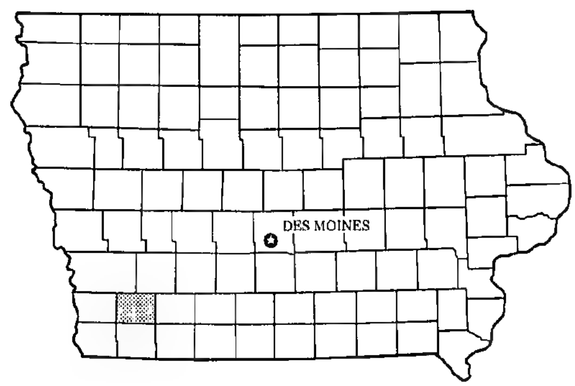


Figure 1.—Location of Montgomery County in Iowa.

General Nature of the County

This section provides general information about Montgomery County. It briefly describes the history and development, relief and drainage, climate, transportation, natural resources, and farming.

The county is mainly rural, but has a few industries. Red Oak, Villisca, and Stanton have grain elevators for shipment of grain by rail. Several towns have livestock auction markets or buying stations.

Most towns have at least one local park. Several county parks are located throughout the county. Viking Lake State Park is located near Stanton.

In rural areas, hunting, fishing, and other types of recreation are available at rivers and creeks.

Montgomery County supports many kinds of wildlife that contribute to its recreation and economy.

History and Development

Montgomery County was the last to be organized in the southwestern part of Iowa. For some time it lagged behind adjacent counties in wealth and population, mainly because the county was off the direct routes of travel.

The area now known as Montgomery County originally was inhabited by the Pottawatami Tribe of the Algonquian family In 1846 Iowa was admitted to the Union. On June 5, 1846, the lands of the Pottawatamis, soon to be Montgomery County, were exchanged for a reservation in Kansas.

The first white man in the county was John Ross, who settled in 1849 about three-fourths mile east of what is now Villisca. By 1851, the county's population had grown to 18 men, including the first elected officials of Montgomery County.

The county was officially organized in 1853. The first county seat was located in the town of Frankfort. In 1865 it was moved, by popular vote, to Red Oak Junction, which was later shortened to Red Oak.

In the early days of the county, the major enterprises were farming, hunting, and grain mills. In 1869, the first railroad service to Montgomery County opened new markets and trade for the county.

Relief and Drainage

The vertical interval between the lowlands and the adjoining uplands generally varies from 100 to 200 feet. The altitude gradually increases toward the divides, which attain an elevation of more than 300 feet above the water level in the East Nishnabotna River.

The highest surface elevations are about 1,300 feet in several places in the county. The lowest elevation is about 990 feet in the East Nishnabotna River where it leaves the county near Coburg.

The topography of Montgomery County is characterized by gently rolling to hilly or steep relief. Typical upland features are smooth, rounded ridges and gentle, uniform slopes, forming a gently rolling landscape. The topography along the East Nishnabotna River, West and Middle Nodaway Rivers, and their tributaries consists of steep, rugged areas. These areas extend back from the river ½ mile to 3 miles, where they merge with the more smoothly rolling topography that dominates the county.

Montgomery County is drained by an extensive network of rivers, creeks, and intermittent drainageways that extend throughout all parts of the county.

The eastern fourth of the county is drained mainly by the West and Middle Nodaway Rivers and their tributaries. The West Nodaway River enters the county 2 miles west of the northeast corner and flows southward, where it leaves the county 4 miles west of the southeast corner. The Middle Nodaway River enters the county 6½ miles north of the southeast corner and flows southwesterly until it joins the West Nodaway River one-half mile north of the southern edge of the county. The middle half of the county is drained primarily by the East Nishnabotna River and its tributaries and by several branches of Tarkio Creek. The East Nishnabotna River enters from the north near the center of the county and flows southward where it leaves the county 6 miles east of the southwest corner.

The main branch of Tarkio Creek enters the county 8 miles west of the northeast corner and flows southward where it leaves the county 11 miles west of the southeast corner. Several other branches of Tarkio Creek enter the county from the south and end within the county. The western fourth of the county is drained mainly by Walnut and Indian Creeks and their tributaries. Walnut Creek enters the county 8 miles east of the northwest corner, flows southwesterly, and leaves the county ½ mile east of the southwest corner. Indian Creek enters the county 3 miles east of the northwest corner, flows southwesterly, and leaves the county near the middle of the west edge of the county.

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Red Oak in the period 1951 to 1984. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 25 degrees F, and the average daily minimum temperature is 15 degrees. The lowest temperature on record, which occurred at Red Oak on January 12, 1974, is -27 degrees. In summer the average temperature is 75 degrees, and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred at Red Oak on July 21, 1974, is 109 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base

temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 34 inches. Of this, about 25 inches, or more than 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 20 inches. The heaviest 1-day rainfall during the period of record was 6.9 inches at Red Oak on August 28, 1977. Thunderstorms occur on about 49 days each year.

The average seasonal snowfall is 31.1 inches. The greatest snow depth at any one time during the period of record was 20 inches. On the average, 29 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 13 miles per hour, in spring.

Transportation Facilities

Montgomery County is served by three major highways. U.S. Highway 34 traverses the county east to west, and intersects U.S. Highways 48 and 71, which both traverse the county north to south. The county road system consists of hard-surfaced and crushed limestone roads. The roads connect the major highways to all the smaller communities and nearly every farm throughout the county.

Burlington Northern Railroad Company has 2 major routes, traversing east to west and north to south, that intersect at Red Oak. Amtrak service is routed through the county, but does not stop until Omaha, Nebraska. Red Oak has bus transportation and a small airport.

Natural Resources

Montgomery County's most valuable natural resource is its agricultural land. Other important natural resources are limestone, sandstone, and the abundant wildlife.

Limestone and sandstone are near the surface in some areas bordering the East Nishnabotna and Nodaway Rivers. Several quarries have been opened up. Generally the stone is crushed and is sold commercially for roadbuilding, for making concrete, and as a source for agronomic uses.

Wildlife of all kinds, including deer, pheasants, and songbirds, flourishes everywhere in the county.

Prospecting for oil is limited, but may become a productive enterprise in the future.

Farming

Farming is of prime importance in Montgomery County. It provides a livelihood not only for farmers, but also for many businesses and professions involved in agribusiness.

Montgomery County has an area of 270,080 acres, or 422 square miles of land. Of this total, about 260,000 acres is farmed. In 1982, the county had 780 farms, which averaged about 333 acres in size. Farms have been decreasing in number, but increasing in average size. The average age of the farm operator has also been decreasing. Fewer and larger farms and increased efficiency account for part of the overall increase in production.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists c assified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way

diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

1. Marshall-Exira Association

Nearly level to moderately steep, well drained, silty soils formed in loess; on uplands

This association consists of soils on moderately wide ridgetops and convex to straight side slopes. Slopes range from 0 to 18 percent.

This association makes up about 44 percent of the county. It is about 45 percent Marshall soils, 25 percent Exira soils, and 30 percent soils of minor extent (fig. 2).

Marshall soils are well drained and on nearly level to moderately sloping, moderately wide, upland ridges and moderately sloping to strongly sloping, narrow ridges and convex or straight upland side slopes. Exira soils are well drained and on moderately sloping to moderately steep, convex or straight upland side slopes surrounding the more stable upland divides and in coves at the head of drainageways.

Typically, the surface layer of Marshall soils is very dark grayish brown, friable silty clay loam about 9 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 8 inches thick. The subsoil is friable silty clay about 36 inches thick. The upper part is dark brown and brown; the next part is brown with mottles; and the lower part is mottled yellowish brown, grayish brown, and dark brown. The substratum to a depth of about 60 inches is mottled dark brown, yellowish brown, and grayish brown silt loam.

Typically, the surface layer of Exira soils is very dark grayish brown, friable silty clay loam about 9 inches thick. Plowing has mixed some streaks and pockets of the brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 32 inches thick. The upper part is brown, the next part is dark yellowish brown and mottled, and the lower part is brown and light brownish gray, and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam.

The minor soils in this association are Ackmore, Adair, Colo, Judson, Malvern, and Shelby soils. Ackmore soils formed in silty alluvium and are somewhat poorly drained. They are on flood plains. Adair soils are downslope from Marshall and Exira soils and are somewhat poorly drained. They formed in a red paleosol weathered from glacial till. Colo soils formed in silty alluvium and are poorly drained. They are on flood plains. Judson soils formed in silty alluvium on foot slopes and have a thick dark colored surface layer. Malvern soils are downslope from Marshall and Exira soils, are slowly permeable, and are moderately well drained or somewhat poorly drained. Malvern soils formed in a red paleosol formed from Loveland Loess. Shelby soils are downstream from Marshall and Exira soils and formed in glacial till.

Most of the soils in this association are used for cultivated crops. Some of the strongly sloping and moderately steep soils are used for permanent pasture. The bottom lands are used for cultivated crops, hay, and permanent pasture and woodland, depending on

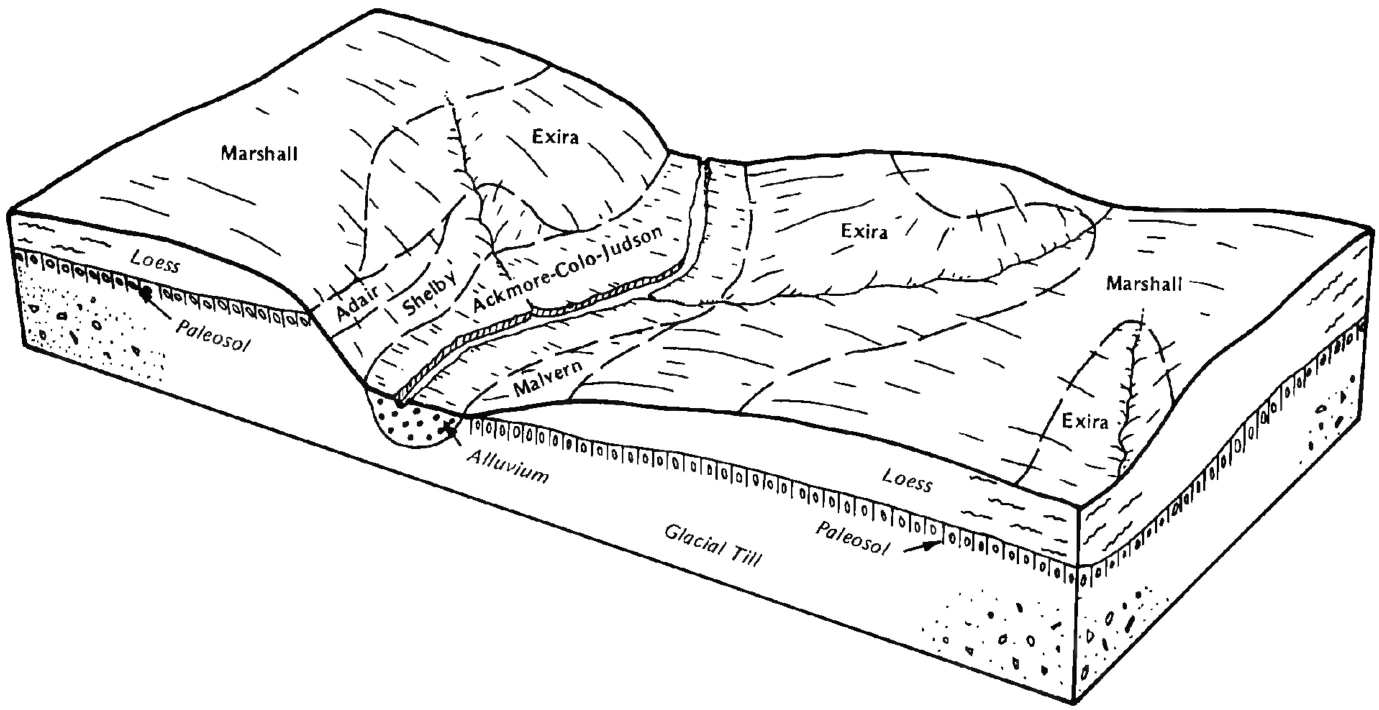


Figure 2.—Typical pattern of soils and parent material in the Marshall-Exira association.

their width and the amount of stream channel meanders.

The main enterprises are growing cash-grain crops and feeding beef cattle.

Corn, soybeans, oats, and hay grow well or moderately well on most of the soils in this association. Available water capacity is high. The main concern of management is controlling water erosion, preventing the formation of gullies, and maintaining fertility.

2. Marshall-Shelby Association

Gently sloping to steep, well drained and moderately well drained, silty and loamy soils formed in loess and glacial till; on uplands and benches

This association consists of soils on narrow ridgetops and smooth convex side slopes, on nose slopes of narrow interfluves in uplands, and on loess-covered benches. Slopes range from 2 to 25 percent.

This association makes up about 23 percent of the county. It is about 40 percent Marshall soils, 24 percent Shelby soils, and 36 percent soils of minor extent.

Marshall soils are well drained and on narrow ridgetops, on the upper part of moderately sloping to strongly sloping convex side slopes, and on gently sloping to moderately sloping loess-covered benches. Shelby soils are moderately well drained and on the lower parts of strongly sloping to steep convex side slopes and nose slopes of narrow interfluves.

Typically, the surface layer of Marshall soils is very dark grayish brown, friable silty clay loam about 9 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is dark brown and brown, the next part is brown with mottles, and the lower part is mottled yellowish brown, grayish brown, and dark brown. The substratum to a depth of about 60 inches is mottled dark brown, yellowish brown, and grayish brown silt loam.

Typically, the surface layer of Shelby soils is very dark gray, friable loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable loam about 5 inches thick. The subsoil is clay loam about 41 inches thick. The upper part is brown and friable, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is grayish brown, mottled clay loam.

The minor soils in this association are Adair, Clarinda, Colo, Judson, and Lamoni soils. Adair soils

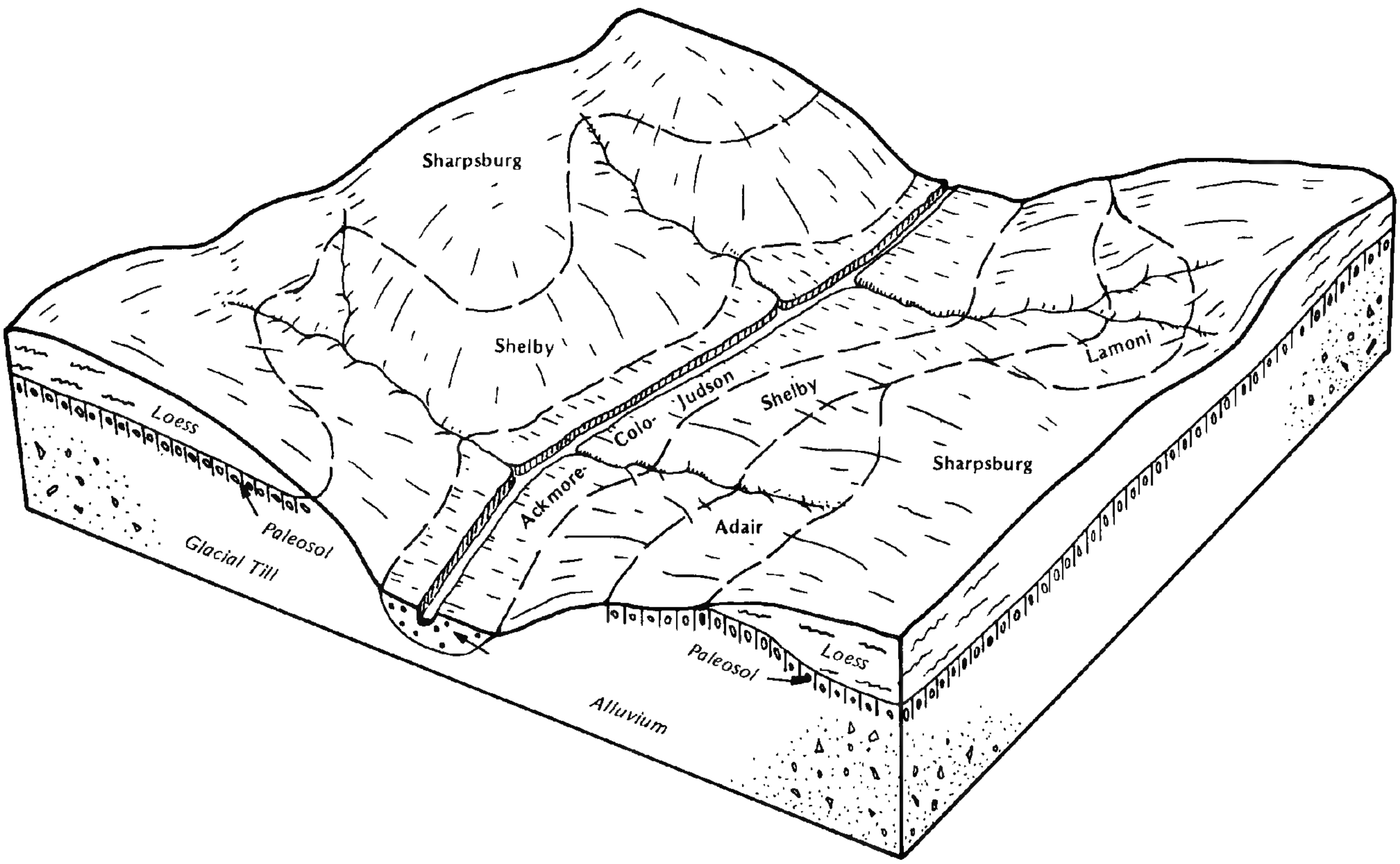


Figure 3.—Typical pattern of soils and parent material in the Sharpsburg-Shelby association.

formed in a red paleosol weathered from glacial till and are upslope from Shelby soils. Clarinda and Lamoni soils formed in a gray clayey paleosol weathered from glacial till. Clarinda and Lamoni soils occur in upland cove positions and on side slopes upslope from Shelby soils. Judson soils formed in silty alluvium on foot slopes, and poorly drained Colo soils formed in silty alluvium on bottom lands.

Most of the soils of this association are used for cultivated crops. Most of the moderately steep and steep areas are used for permanent pasture. The bottom lands are used for cultivated crops, hay, and permanent pasture, and as woodland, depending on their width and the amount of stream channel meanders. The main enterprises are growing cash-grain crops and feeding beef cattle.

Corn, soybeans, oats, and hay grow well or moderately well on most of the soils of this association. Available water capacity is high. Organic matter content is moderate. The main concern of management is controlling water erosion, preventing the formation of gullies, and maintaining fertility.

3. Sharpsburg-Shelby Association

Gently sloping to steep, moderately well drained, silty and loamy soils formed in loess and glacial till; on uplands and benches

This association consists of soils on narrow, convex ridgetops; on convex side slopes; on the nose slopes of narrow interfluves; and on loess-covered benches. Slopes range from 2 to 25 percent.

This association makes up about 12 percent of the county. It is about 46 percent Sharpsburg soils, 17 percent Shelby soils, and 37 percent soils of minor extent (fig. 3).

Sharpsburg soils are moderately well drained and on gently sloping, narrow convex ridgetops; on moderately

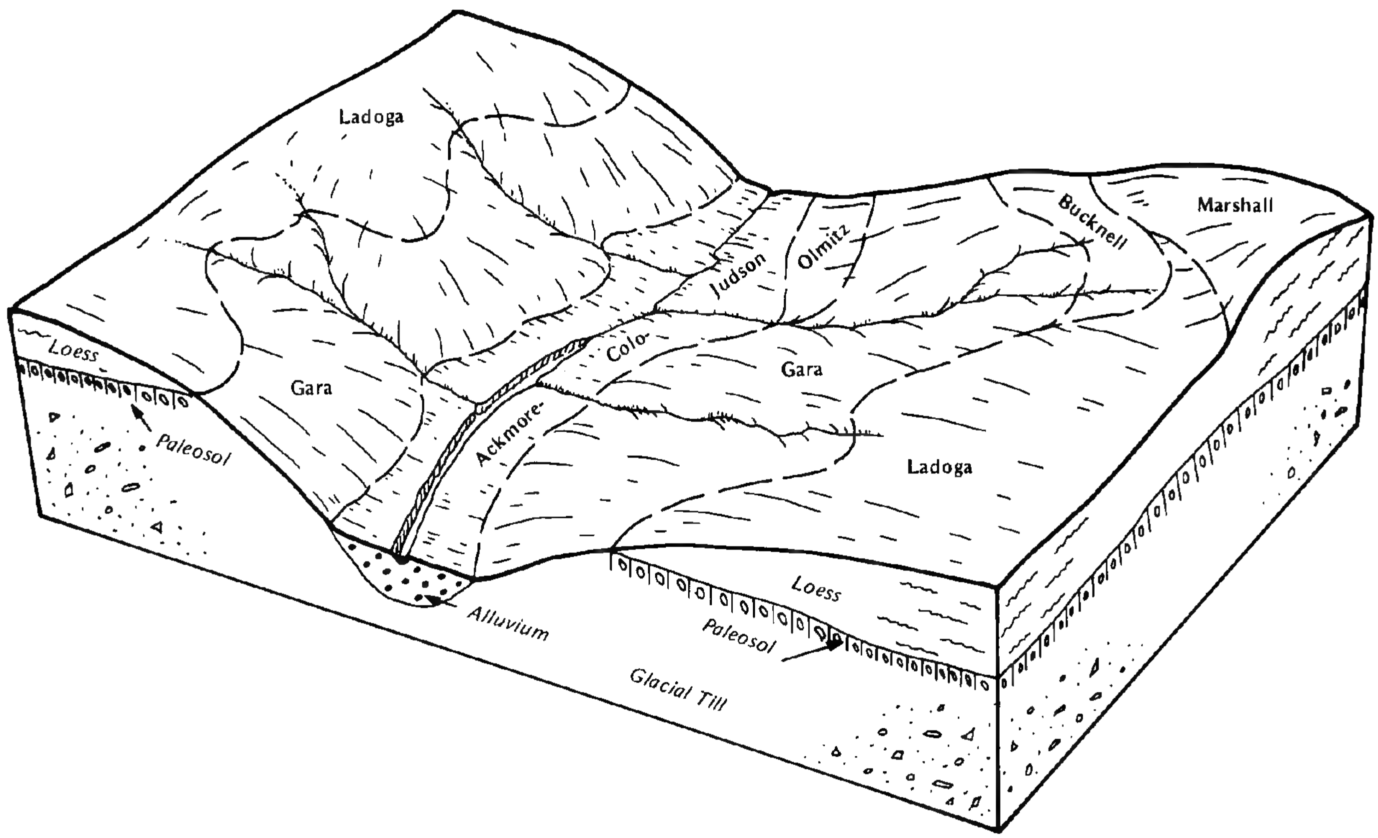


Figure 4.—Typical pattern of soils and parent material in the Gara-Ladoga association.

sloping and strongly sloping convex side slopes; and on gently sloping and moderately sloping loess-covered benches. Shelby soils are moderately well drained and on strongly sloping to steep convex side slopes and on nose slopes of narrow interfluves.

Typically, the surface layer of Sharpsburg soils is black, friable silty clay loam about 9 inches thick. The subsurface layer is very dark grayish brown and dark brown, friable silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 35 inches thick. The upper part is brown; the next part is brown and mottled; and the lower part is mottled brown, grayish brown, and dark brown. The substratum to a depth of about 60 inches is mottled grayish brown and strong brown silty clay loam.

Typically, the surface layer of Shelby soils is very dark gray, friable loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable loam about 5 inches thick. The subsoil is clay loam about 41 inches thick. The upper part is brown and friable; and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is grayish brown, mottled clay loam.

The minor soils in this association are Ackmore, Adair, Colo, Judson, and Lamoni soils. Ackmore soils are somewhat poorly drained and formed in silty alluvium on flood plains. Adair soils formed in a red paleosol weathered from glacial till and are upslope from Shelby soils. Colo soils are poorly drained and formed in silty alluvium on bottom lands. Judson soils formed in alluvium on foot slopes and are downslope from Sharpsburg soils. Lamoni soils formed in a gray clayey paleosol weathered from glacial till and are upslope from Shelby soils.

Most of the soils in this association are used for cultivated crops. Most of the moderately steep and steep soils are used for permanent pasture. The bottom lands, depending on their width and the amount of stream channel meanders, are used for cultivated crops, hay, permanent pasture, and woodland. The

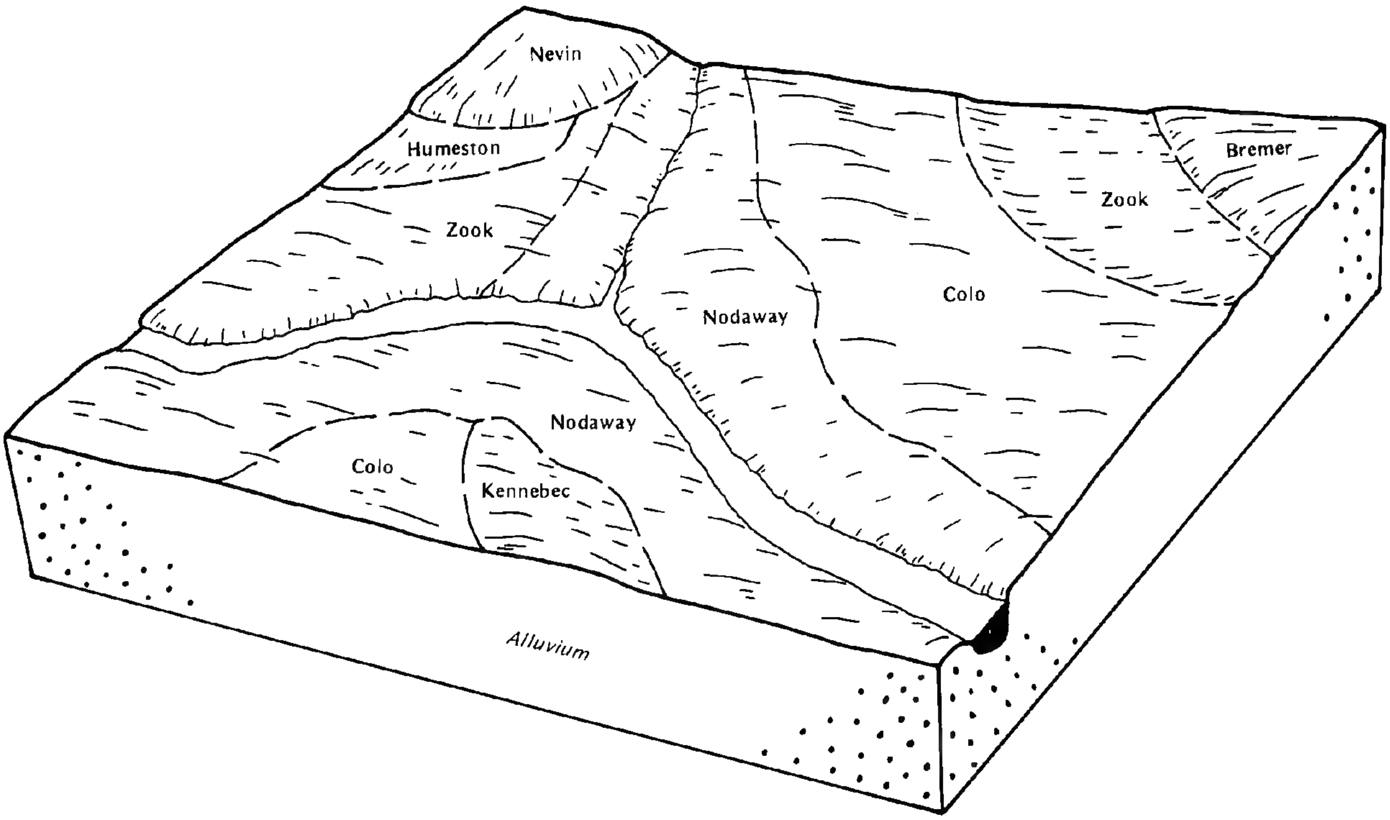


Figure 5.—Typical pattern of soils and parent material in the Nodaway-Colo-Zook association.

main enterprises are growing cash-grain crops and feeding beef cattle.

Corn, soybeans, oats, and hay grow well or moderately well on most of the soils of this association. Available water capacity is high. Organic matter content is moderate. The main concern of management is controlling water erosion, preventing the formation of gullies, and maintaining fertility.

4. Gara-Ladoga Association

Gently sloping to steep, moderately well drained, loamy and silty soils formed in glacial till and loess; on uplands

This association consists of soils on narrow convex ridgetops and dissected side slopes. Slopes range from 2 to 25 percent.

This association makes up about 6 percent of the county. It is about 37 percent Gara soils, 28 percent Ladoga soils, and 35 percent soils of minor extent (fig. 4).

Gara soils are moderately well drained and on the lower parts of strongly sloping to steep, convex upland side slopes. Ladoga soils are moderately well drained and on gently sloping and moderately sloping, narrow convex ridgetops and on moderately sloping and strongly sloping upper side slopes.

Typically, the surface layer of Gara soils is very dark gray, friable loam about 7 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil is clay loam about 35 inches thick. The upper part is brown and friable; the next part is dark yellowish brown, mottled, and firm; and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam.

Typically, the surface layer of Ladoga soils is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 3 inches thick. The subsoil is silty clay about 45 inches thick. The upper part is dark yellowish brown and friable; the next part is yellowish brown, mottled, and firm; and the lower part is mottled

grayish brown, yellowish brown, and strong brown and friable. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam.

The minor soils in this association are Ackmore, Bucknell, Colo, Judson, Marshall, and Olmitz soils. Ackmore soils are somewhat poorly drained and formed in silty alluvium on flood plains. Bucknell soils formed in a gray clayey paleosol weathered from glacial till. They are in upland cove positions and on side slopes upslope from Gara soils. Colo soils are poorly drained, formed in silty alluvium, and have a thick, dark colored surface soil. They are on flood plains. Judson soils are well drained and on upland foot slopes. Marshall soils formed in loess upslope from Gara and Ladoga soils and have a thicker dark colored surface layer. Olmitz soils formed in loamy alluvium on foot slopes and have a thick, dark colored surface soil.

Most of the gently sloping and strongly sloping areas are used for cultivated crops. Most of the moderately steep and steep areas are used as permanent pasture, woodland, and wildlife habitat. The bottom lands, depending on their width and the amount of stream channel meanders, are used for cultivated crops, hay, and permanent pasture, and as woodland. The main enterprises are growing cash-grain crops and feeding beef cattle.

Corn, soybeans, oats, and hay grow moderately well on the gently sloping and strongly sloping soils in this association. Available water capacity is high.

The main concerns of management are controlling water erosion, preventing the formation of gullies, and maintaining fertility.

5. Nodaway-Colo-Zook Association

Nearly level, moderately well drained and poorly drained, silty and clayey soils formed in alluvium; on bottom land

This association consists of soils on moderately wide to wide bottom lands along major streams and rivers. Slopes range from 0 to 2 percent.

This association makes up about 15 percent of the county. It is about 30 percent Nodaway soils, 25 percent Colo soils, 20 percent Zook soils, and 25 percent soils of minor extent (fig. 5).

Nodaway soils are moderately well drained and are on moderately wide and wide, nearly level bottom lands. They generally are adjacent to stream channels. Colo and Zook soils are poorly drained and are on moderately wide and wide, nearly level bottom lands. They generally are away from stream channels.

Typically, the surface layer of Nodaway soils is very dark grayish brown, friable silt loam about 8 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, grayish brown, and very dark grayish brown, stratified silt loam.

Typically, the surface layer of Colo soils is black, friable silty clay loam about 8 inches thick. The subsurface layer is black, friable silty clay loam about 24 inches thick. The subsoil is very dark gray, mottled, friable, silty clay loam about 11 inches thick. The substratum to a depth of about 60 inches is very dark gray, mottled silty clay loam.

Typically, the surface layer of Zook soils is black, friable silty clay loam or silty clay about 7 inches thick. The surface layer is about 23 inches thick. The upper part is black, friable silty clay loam; and the lower part is very dark gray, firm silty clay. The subsoil is very dark gray and dark gray, mottled, firm silty clay about 22 inches thick. The substratum to a depth of about 60 inches is dark gray, mottled silty clay. In some places the surface layer is overlain by about 12 inches of recently deposited silt loam. In other places it is silty clay. In some places the subsoil contains less clay and the substratum is calcareous.

The minor soils in this association are Ackmore, Bremer, Humeston, Kennebec, and Nevin soils. Ackmore soils are somewhat poorly drained, have a black buried soil at depths of 20 to 40 inches, and are near the stream channels. Bremer soils are poorly drained, and are at slightly higher elevations away from stream channels. Humeston soils are very poorly drained and are in slightly depressional areas. Kennebec soils generally are adjacent to stream channels with Nodaway soils. They have darker colors throughout, and are not stratified. Nevin soils are somewhat poorly drained and are on higher areas.

Most areas of this association are used for cultivated crops. Some areas near stream channels with numerous meander channels are used for permanent pasture and woodlands. The main enterprises are growing cash-grain crops and feeding beef cattle.

Corn, soybeans, oats, and hay grow well on most of the soils of this association. The soils of this association have a moderate to high available water capacity and organic matter content. The main concerns of management are protecting these soils from flooding and providing drainage.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Marshall silty clay loam, 2 to 5 percent slopes, is a phase of the Marshall series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, sand and gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

8B—Judson silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on foot slopes and alluvial fans below upland drainageways. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is friable silty clay loam about 17 inches thick. The upper part is black, and the lower part is very dark grayish brown. The subsoil is friable silty clay loam about 24 inches thick. The upper part is dark brown and dark yellowish brown, and the lower part is dark yellowish brown and mottled. The substratum to a depth of about 60 inches is dark yellowish brown, mottled silty clay loam.

Included with this soil in mapping are some small areas of the nearly level, poorly drained Colo soils. These soils dry out more slowly after rains than the

Judson soil. They make up less than 10 percent of the unit.

Permeability of the Judson soil is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas runoff from soils upslope results in siltation and gullying. Measures that control the runoff on the soils upslope are needed. Grassed waterways help to remove excess water and prevent gullying. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is IIe.

8C—Judson silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on foot slopes and alluvial fans below upland drainageways. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is friable silty clay loam about 20 inches thick. The upper part is black, and the lower part is very dark grayish brown. The subsoil is friable silty clay loam about 22 inches thick. The upper part is dark brown and dark yellowish brown, and the lower part is dark yellowish brown and mottled. The substratum to a depth of about 60 inches is dark yellowish brown, mottled silty clay loam.

Permeability of the Judson soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. Contour stripcropping, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. In some areas runoff from soils upslope results in siltation and gullying. Measures that control the runoff on the soils upslope are needed. Grassed waterways help to remove excess water and prevent gullying. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is IIIe.

9—Marshall silty clay loam, 0 to 2 percent slopes. This nearly level, well drained soil is on broad, stable upland ridgetops. Areas range from 5 to 100 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown, friable silty clay loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silty clay loam about 9 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is brown, and the lower part is brown, dark yellowish brown, and yellowish brown and is mottled. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silt loam. In some places the subsoil is dark grayish brown.

Permeability of the Marshall soil is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3.5 to 4.5 percent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

The land capability classification is I.

9B—Marshall silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on broad upland ridgetops. Areas range from 5 to 100 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown, friable silty clay loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is dark brown, and the lower part is brown, dark brown, and yellowish brown and is mottled. The substratum to a depth of about 60 inches is mottled

yellowish brown and grayish brown silt loam.

Permeability of the Marshall soil is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

9C—Marshall silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown, friable silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 5 inches thick. The subsoil is friable silty clay loam about 34 inches thick. The upper part is dark brown, and the lower part is brown, dark brown, and yellowish brown and is mottled. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown silt loam. In places gray mottles are within a depth of 24 inches.

Permeability of the Marshall soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. Contour stripcropping, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

9C2—Marshall silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on upland side slopes. Areas range from 5 to 100 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark brown silty clay loam subsoil material into the surface layer. The subsoil is friable silty clay loam about 34 inches thick. The upper part is dark brown, and the lower part is brown, dark yellowish brown, and yellowish brown and is mottled. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown silt loam. In some places gray mottles are within a depth of 24 inches, and in other places the surface layer is more than 7 inches thick.

Included with this soil in mapping are small areas of the severely eroded Marshall soils. These moderately sloping soils are on short convex side slopes. They make up less than 10 percent of the unit.

Permeability of the Marshall soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and

prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

9D—Marshall silty clay loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 9 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is dark brown and brown; the middle part is brown and is mottled; and the lower part is mottled yellowish brown, grayish brown, and dark brown. The substratum to a depth of about 60 inches is mottled dark brown, yellowish brown, and grayish brown silt loam. In places gray mottles are within a depth of 24 inches.

Permeability of this Marshall soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

9D2—Marshall silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on upland side slopes. Areas range from 5 to 100 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 36 inches thick. The upper part is dark brown, and the lower part is dark brown, dark yellowish brown, and yellowish brown and is mottled. The substratum to a depth of about 60 inches is mottled dark yellowish brown, yellowish brown, and grayish brown silt loam. In some places gray mottles are within a depth of 24 inches, and in other places the surface layer is more than 7 inches thick.

Permeability of the Marshall soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Tilth generally is good. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

11B—Ackmore-Colo-Judson complex, 2 to 5 percent slopes. These gently sloping soils are along drainageways. The Ackmore soil is somewhat poorly drained and in narrow bands along stream channels. The Colo soil is poorly drained and on the lower parts of the landscape adjacent to the stream channel. The Judson soil is well drained and on foot slopes slightly higher in elevation. The unit is about 45 percent

Ackmore so l, 35 percent Colo soil, and 20 percent Judson soil The Ackmore and Colo soils are subject to occasional flooding. The soils in this unit are in areas so small and so narrow that mapping them separately is impractical. Areas range from 5 to 75 acres in size.

Typically, the surface layer of the Ackmore soil is very dark grayish brown, friable silt loam about 9 inches thick. The substratum is stratified very dark grayish brown, very dark gray, and dark grayish brown silt loam about 19 inches thick. Below this, to a depth of about 60 inches, is a buried layer of black silty clay loam. In places silt loam is at a depth of more than 40 inches.

Typically, the surface layer of the Colo soil is black, friable silty clay loam about 8 inches thick. The subsurface layer is black, friable silty clay loam about 24 inches thick. The subsoil is very dark gray, firm, mottled silty clay loam about 11 inches thick. The substratum to a depth of about 60 inches is very dark gray and very dark grayish brown silty clay loam. In some places it is silty clay. In other places about 12 inches of recently deposited silt loam overlies the surface layer.

Typically, the surface layer of the Judson soil is black, friable silty clay loam about 9 inches thick. The subsurface layer is friable silty clay loam about 17 inches thick. The upper part is black, and the lower part is very dark grayish brown. The subsoil is friable silty clay loam about 24 inches thick. The upper part is dark brown and dark yellowish brown, and the lower part is dark yellowish brown and mottled. The substratum to a depth of about 60 inches is dark yellowish brown, mottled silty clay loam.

Permeability of the Ackmore, Colo, and Judson soils s moderate, and runoff is slow. Available water capacity is very high in the Ackmore soil and high in the Judson and Colo soils. In the Ackmore and Colo soils the seasonal high water table is at a depth of 1 to 3 feet from November to July. The content of organic matter in the surface layer is about 1 to 3 percent in the Ackmore soil, about 5 to 7 percent in the Colo soil, and about 3.5 to 4.5 percent in the Judson soil. The substratum of the Ackmore soil generally has a low or very low supply of available phosphorus and potassium, the substratum of the Colo soil generally has a medium supply, and the subsoil of the Judson soil generally has a low supply.

Most areas are cultivated. These soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas a drainage system is needed to lower the water table and provide good aeration and a deep root zone for plants. Tile drains work well in the Ackmore and Colo soils if they are properly installed and if an adequate outlet is available. Tilth typically is good in the surface layer of the Ackmore and Judson soils and fair in the Colo soil. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soils are wet improve tilth and fertility, prevent surface crusting, and increase the rate of water infiltration.

If these soils are used for pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is IIw.

24D—Shelby loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on convex side slopes in uplands. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 7 inches thick. The subsurface layer is dark brown, friable clay loam about 5 inches thick. The subsoil is clay loam about 41 inches thick. The upper part is brown and friable, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is grayish brown, mottled clay loam. In some places the subsoil is reddish brown and contains more clay. In other places the soil is calcareous.

Included with this soil in mapping are some small areas of Clarinda and Lamoni soils. These soils are in narrow bands above the Shelby soil on the upper part of side slopes. Clarinda and Lamoni soils have a grayer, more clayey subsoil than the Shelby soil. They make up less than 10 percent of the unit.

Permeability of the Shelby soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most large areas are pasture and in grass. Some areas are cultivated. In most areas this soil is managed along with the adjacent soils. It is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in

controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

24D2—Shelby loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes in uplands. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark brown clay loam subsoil material into the surface layer. The subsoil is firm clay loam about 41 inches thick. The upper part is dark brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is grayish brown, mottled clay loam. Pebbles are in the subsoil and substratum. In some places the subsoil is reddish brown and contains more clay. In other places the soil is calcareous.

Included with this soil in mapping are some small areas of Clarinda and Lamoni soils. These soils occur in narrow bands above the Shelby soil on the upper part of side slopes. Clarinda and Lamoni soils have a grayer, more clayey subsoil than the Shelby soil. They make up less than 10 percent of the unit.

Permeability of the Shelby soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Some areas are cultivated, but the larger areas are in pasture. In most areas this soil is managed along with the adjacent soils. It is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Unless the stones on the surface in some areas are removed, they can cause damage to farm equipment. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

24E—Shelby loam, 14 to 18 percent slopes. This moderately steep, moderately well drained soil is on convex side slopes in uplands. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable loam about 4 inches thick. The subsoil is clay loam about 32 inches thick. The upper part is dark brown and friable; the next part is dark yellowish brown, mottled, and firm; and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is grayish brown, mottled clay loam. In some places the soil is calcareous.

Permeability of the Shelby soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

In most areas this soil is in pasture or hay. It is poorly suited to corn, soybeans, and small grain mainly because of the slope and the severe hazard of water erosion. It is moderately suited to grasses and legumes for hay and pasture.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

24E2—Shelby loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on convex side slopes in uplands. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark brown clay loam subsoil material into the surface layer. The subsoil is clay loam about 28 inches thick. The upper part is dark brown and friable; the next part is dark yellowish

brown and yellowish brown, mottled, and firm; and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is grayish brown, mottled clay loam. Stones and pebbles are in the subsoil and substratum. In some places the surface layer is more than 7 inches thick and is very dark gray. In other places the soil is calcareous.

Included with this soil in mapping are some small areas of the severely eroded Shelby soils. These soils are moderately steep and on short convex side slopes. Stones and pebbles are on the surface of these soils. These soils make up less than 10 percent of the unit.

Permeability of the Shelby soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated, but some areas are used for hay or pasture. This soil is poorly suited to corn, soybeans, and small grain, mainly because it is subject to water erosion. It is moderately suited to grasses and legumes for hay and pasture. Tilth generally is fair in the surface layer.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

24F—Shelby loam, 18 to 25 percent slopes. This steep, moderately well drained soil is on upland side slopes. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown, friable loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable clay loam about 5 inches thick. The subsoil is firm clay loam about 30 inches thick. The upper part is brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is grayish brown, mottled clay loam. In some places the surface layer is less than 8 inches thick. In other places the soil is calcareous.

Permeability of the Shelby soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are in pasture. This soil is generally unsuited to corn, soybeans, and small grain, mainly because it is subject to a severe hazard of water erosion. It is moderately suited to grasses and legumes for hay and pasture. Tilth generally is good in the surface layer.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIe.

33D2—Steinauer clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex side slopes in uplands. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable, calcareous clay loam about 6 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown clay loam substratum material into the surface layer. Below this is a transitional layer about 14 inches thick. It is dark yellowish brown and yellowish brown, friable clay loam. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled, calcareous clay loam. It contains pebbles. In some places the surface layer is more than 6 inches thick. In other places the soil is not calcareous.

Included with this soil in mapping are some small areas of severely eroded Steinauer soils. These soils are on short convex side slopes. Stones and pebbles are on the surface of these soils. These soils make up less than 10 percent of the unit.

Permeability of the Steinauer soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The substratum generally has a very low supply of available phosphorus and potassium.

Most areas are used for pasture, but some are cultivated. In most areas this soil is managed along with the adjacent soils. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the

soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Species that can grow well in calcareous soils should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

33E2—Steinauer clay loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on convex side slopes in uplands. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable, calcareous clay loam about 6 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown substratum material into the surface layer. Below this is a transition layer about 14 inches thick. It is dark yellowish brown and yellowish brown, friable clay loam. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled, calcareous clay loam. In some places the surface layer is more than 6 inches thick. In other places the soil is not calcareous.

Included with this soil in mapping are some small areas of the severely eroded Steinauer soils. These soils are on short convex side slopes. Stones and pebbles are on the surface of these soils. These soils make up less than 10 percent of the unit.

Permeability of the Steinauer soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The substratum generally has a very low supply of available phosphorus and potassium.

Most areas are used for pasture, but some areas are cultivated. In most areas this soil is managed along with the adjacent soils. It is generally unsuited to corn, soybeans, and small grain. It is moderately suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to improve tilth and fertility, prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Species that can grow well in calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIe.

43—Bremer silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on second bottoms on flood plains. It is subject to occasional flooding. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsurface layer is black, friable silty clay loam about 9 inches thick. The subsoil is mottled, firm silty clay loam about 31 inches thick. The upper part is very dark gray, and the lower part is dark grayish brown and gray. The substratum to a depth of about 60 inches is gray, mottled silty clay loam. In some places the dark surface soil extends to a depth of 36 inches or more. In other places the soil is somewhat poorly drained.

Included with this soil in mapping are some small areas of Zook soils. These soils contain more clay in the subsoil than the Bremer soil. Also, they are lower on the landscape and dry out more slowly. They make up less than 10 percent of the unit.

Permeability of the Bremer soil is moderately slow, and runoff is slow. The soil has a seasonal high water table. Available water capacity is high. The content of organic matter in the surface layer is about 5 to 7 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Flooding is a hazard. Installing a drainage system helps to lower the water table and provide good aeration and a deep root zone for plants. Surface drains are needed in some areas. Tile drains work well if they are properly installed and if an adequate outlet is available. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is IIw.

54—Zook silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is at the lower elevations on flood plains. It is subject to occasional flooding. Areas range from 5 to 100 acres in size and are wide and irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 7 inches thick. The subsurface layer is about 23 inches thick. The upper part is black, friable silty clay loam; the lower part is very dark gray, firm silty clay. The subsoil is very dark gray and dark gray, mottled, firm silty clay about 22 inches thick. The substratum to a depth of about 60 inches is dark gray, mottled silty clay. In some places the surface layer is overlain by about 12 inches of recently deposited silt loam. In other places it is silty clay. In some places the subsoil contains less clay and the substratum is calcareous.

Included with this soil in mapping are some small areas of Bremer soils. These soils are slightly higher on the landscape than the Zook soil. They make up less than 10 percent of the unit.

Permeability of the Zook soil is slow, and runoff is slow. The soil has a seasonal high water table. Available water capacity is high. The content of organic matter in the surface layer is about 5 to 7 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated (fig. 6). If adequately drained, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Flooding is a hazard. Installing a drainage system helps to lower the water table and provide good aeration and a deep root zone for plants. Tile drains generally work satisfactorily only if they are closely spaced and if an adequate outlet is available. In some areas surface drains are needed to remove surface water. Tilth generally is fair in the surface layer. Returning crop residue to the soil and deferring tillage when the soil is wet help to maintain tilth.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth.

The land capability classification is IIw.

54+—Zook silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is at the lower elevations on flood plains. It is subject to occasional flooding. Areas range from 5 to 75 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is recently deposited alluvium about 12 inches thick. It is very dark grayish brown or dark grayish brown, friable silt loam. Below this is about 17 inches of black silty clay loam and about 15 inches of black silty clay. The subsoil is very dark gray, mottled, firm silty clay about 12 inches thick. The substratum to a depth of about 60 inches is dark gray, mottled silty clay. In some places the dark underlying layers are calcareous. In other places the subsoil contains less clay.

Included with this soil in mapping are some small areas of the somewhat poorly drained Ackmore soils. These soils are slightly higher on the landscape than the Zook soil and dry out more rapidly after rains. They make up less than 10 percent of the unit.

Permeability of the Zook soil is slow, and runoff is slow. The soil has a seasonal high water table. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 4 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. If adequately drained, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Flooding is a hazard. Installing a drainage system helps to lower the water table and provide good aeration and a deep root zone for plants. Tile drains generally work satisfactorily only if they are closely spaced and if an adequate outlet is available. In some areas surface drains are needed to remove surface water. Good tilth generally can be easily maintained. Returning crop residue to the soil and deferring tillage when the soil is wet help to maintain tilth.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth.

The land capability classification is IIw.

60D2—Malvern silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on convex side slopes in uplands. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of the dark yellowish brown subsoil material into the surface layer. The subsoil to a depth of about 60 inches is mottled silty clay loam and silty clay. The upper part is dark yellowish brown and friable; the next part is dark brown, brown, and reddish brown and very firm; and the lower part is brown and yellowish red and very firm. In some places the surface layer is more than 7 inches thick. In other places the subsoil is silty clay loam.

Permeability of the Malvern soil is slow, and runoff is rapid. The soil has a seasonal high water table. Available water capacity is high. The content of organic

Figure 6.—Soybeans on Zook silty clay loam, 0 to 2 percent slopes.

matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated, and some are in pasture. In most areas this soil is managed along with the adjacent soils. It is poorly suited to corn, soybeans, and small grain and is suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. In some areas interceptor tile is needed upslope to lower the water table and control seepage on this soil. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

76B—Ladoga silt loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on the summit of moderately wide ridges in uplands. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 3 inches thick. The subsoil is silty clay loam about 45 inches thick. The upper part is brown and friable; the next part is brown and dark yellowish brown, mottled, and firm; and the lower part is yellowish brown and brown, friable, and mottled. The substratum to a depth of about 60 inches is grayish brown and yellowish brown, mottled silty clay loam.

Permeability of the Ladoga soil is moderately slow, and runoff is medium. Available water capacity is high.

The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated, but some are used for pasture and hay. This soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and delaying tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

76C—Ladoga silt loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex side slopes in uplands. Areas range from 10 to 14 acres in size and are long and narrow.

Typically, the surface layer is very dark gray, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 3 inches thick. The subsoil s silty clay loam about 45 inches thick. The upper part is brown and friable; the next part is yellowish brown, mottled, and firm; and the lower part is grayish brown and yellowish brown, mottled, and friable. The substratum to a depth of about 60 inches is grayish brown and brown, mottled silty clay loam. In some places the surface layer is less than 7 inches thick.

Permeability of the Ladoga soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium.

Most areas are in pasture or timber, but some are cultivated or are in hay. This soil is moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and delaying tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

76C2—Ladoga silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex side slopes in uplands. Areas range from 10 to 40 acres in size and are long and narrow.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown silty clay loam subsoil material into the surface layer. The subsoil is silty clay loam about 45 inches thick. The upper part is brown and friable; the next part is yellowish brown, mottled, and firm; and the lower part is brown and yellowish brown, mottled, and friable. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silty clay loam. In places the surface layer is more than 7 inches thick.

Permeability of the Ladoga soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated, but some are used for pasture and hay. This soil s moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

76D—Ladoga silt loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on convex side slopes in uplands. Areas range from 10 to 30 acres in size and are long and narrow.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 3 inches thick. The subsoil is silty clay loam about 45 inches thick. The upper part is dark yellowish brown and friable; the next part is yellowish brown, mottled, and firm; and the lower part is mottled grayish brown, yellowish brown, and strong brown and friable. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam. In places the surface layer is less than 9 inches thick.

Permeability of the Ladoga soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated, but some areas are used for pasture and hay. This soil is moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and delaying tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

76D2—Ladoga silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes in uplands. Areas range from 10 to 40 acres in size and are long and narrow.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown silty clay loam subsoil material into the surface layer. The subsoil is silty clay loam about 45 inches thick. The upper part is dark yellowish brown and friable and firm; the next part is yellowish brown, mottled, and firm; and the lower part is mottled yellowish brown, grayish brown, and strong brown and friable. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam.

Permeability of the Ladoga soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated, but some are used for pasture and hay. This soil is moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and delaying tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

88—Nevin silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on low alluvial terraces or second bottoms. This soil is subject to rare flooding. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is black and

very dark gray, friable silty clay loam about 15 inches thick. The subsoil is silty clay loam about 29 inches thick. The upper part is dark grayish brown and friable; the next part is dark grayish brown and brown, mottled, and firm; and the lower part is grayish brown, mottled, and friable. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam.

Permeability of the Nevin soil is moderate, and runoff is slow. The soil has a seasonal high water table. Available water capacity is very high. The content of organic matter in the surface layer is about 4 to 6 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Tile drains generally are not needed, but are beneficial in some areas. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is I.

93D2—Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded. These strongly sloping soils are on short convex upland side slopes. The Shelby soil is moderately well drained and on the lower slopes, and the Adair soil is somewhat poorly drained and on the upper slopes. Areas range from 5 to 30 acres in size and are irregularly shaped. The unit is about 55 percent Shelby soil, 35 percent Adair soil, and 10 percent soils of minor extent. The two soils occur as areas so small or so intermingled that mapping them separately is impractical.

Typically, the surface layer of the Shelby soil is very dark gray, friable loam about 7 inches thick. The subsoil is firm clay loam about 41 inches thick. The upper part is dark brown and mottled, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is grayish brown, mottled clay loam. In other places the soil is calcareous.

Typically, the surface layer of the Adair soil is very dark grayish brown, friable clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of the dark brown clay subsoil material into the surface layer. The firm subsoil is about 44 inches thick. The upper part is dark brown, mottled clay; the next part is dark brown and dark reddish brown, mottled clay; and the lower part is dark yellowish brown and yellowish brown, mottled clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam. A band of pebbles is at the base of the surface layer. Some pebbles are throughout the subsoil. In some places the surface layer is more than 8 inches thick and the subsoil or substratum does not have pebbles.

Permeability is moderately slow in the Shelby soil and slow in the Adair soil. Runoff is rapid. Available water capacity is high in the Shelby soil and moderate in the Adair soil. The Adair soil has a seasonal high water table. In the Shelby and Adair soils the content of organic matter in the surface layer is about 2 to 3 percent. The subsoil of the Shelby and Adair soils generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated, but some large areas are used for pasture. In most areas these soils are managed together with the adjacent soils. They are poorly suited to corn, soybeans, and small grains and are moderately suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soils are wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

99C2—Exira silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on side slopes in uplands. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 9 inches thick. Plowing has mixed some streaks and pockets of brown silty clay loam subsoil material into the surface layer. The subsoil is friable and about 32 inches thick. The upper part is brown silty clay loam; the lower part is brown and yellowish brown, mottled silty clay loam. The

substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam. In places the subsoil is grayish brown within a depth of 24 inches.

Permeability of the Exira soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

99D2—Exira silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on side slopes in uplands. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 9 inches thick. Plowing has mixed some streaks and pockets of the brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 32 inches thick. The upper part is brown, the next part is dark yellowish brown and mottled, and the lower part is brown and light brownish gray and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam. In places the soil does not have grayish mottles within a depth of 24 inches.

Permeability of the Exira soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

99D3—Exira silty clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on long side slopes in uplands. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is brown, friable silty clay loam about 6 inches thick. It contains only 10 to 15 percent streaks and pockets of the very dark grayish brown original surface layer material. The subsoil is friable silty clay loam about 24 inches thick. The upper part is brown, and the lower part is dark yellowish brown and brown, and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam. In places the subsoil is grayish brown within a depth of 24 inches. In other places the surface layer is more than 6 inches thick.

Permeability of the Exira soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is poorly suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding

other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

99E2—Exira silty clay loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on side slopes in uplands. Areas range from 5 to 15 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown silty clay loam subsoil material into the surface layer. The subsoil is friable silty clay loam about 22 inches thick. The upper part is brown, and the lower part is dark yellowish brown and brown, and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam. In places the soil does not have grayish mottles within a depth of 24 inches. In other places the surface layer is more than 7 inches thick.

Permeability of the Exira soil is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is poorly suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is at the lower elevations on flood plains. It is subject to occasional flooding. Areas generally range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsurface layer is black, friable silty clay loam about 24 inches thick. The subsoil is very dark gray, mottled, friable silty clay loam about 11 inches thick. The substratum to a depth of about 60 inches is very dark gray, mottled silty clay loam. In some places it is silty clay or is calcareous. In other places about 12 inches of recently deposited silt loam overlies the surface layer.

Included with this soil in mapping are small areas of the well drained Judson soils and the moderately well drained Kennebec soils. These soils are slightly higher on the landscape than the Colo soil, can be tilled more easily, and dry out more rapidly after rains. They make up less than 10 percent of the unit.

Permeability of the Colo soil is moderate, and runoff is slow. The soil has a seasonal high water table. Available water capacity is high. The content of organic matter in the surface layer is about 5 to 7 percent. The substratum generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. A drainage system is needed to lower the water table and provide good aeration and a deep root zone for plants. Tile drains work well if they are properly installed and if an adequate outlet is available. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is IIw.

133+—Colo silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is at the

lower elevations on flood plains. It is subject to occasional flooding. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is recently deposited alluvium about 12 inches thick. It is very dark grayish brown or dark grayish brown, friable silt loam. The subsurface layer is black, friable silty clay loam about 32 inches thick. The subsoil is very dark gray, mottled, friable silty clay loam about 11 inches thick. The substratum to a depth of about 60 inches is very dark gray, mottled silty clay loam. In some places the underlying soil is calcareous throughout. In other places it is silt loam throughout.

Included with this soil in mapping are some small areas of the somewhat poorly drained Ackmore soils. Ackmore soils are slightly higher on the landscape than the Colo soil and dry out more rapidly after rains. They make up less than 10 percent of the unit.

Permeability of this Colo soil is moderate, and runoff is slow. The soil has a seasonal high water table. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 5 percent. The substratum generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. A drainage system is needed to lower the water table and provide good aeration and a deep root zone for plants. Tile drains work well if they are properly installed and if an adequate outlet is available. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is IIw.

134—Zook silty clay, 0 to 2 percent slopes. This nearly level, poorly drained soil is at the lower elevations on bottom land. It is subject to occasional flooding. Areas range from 20 to 50 acres in size and are wide and irregularly shaped.

Typically, the surface layer is black, friable silty clay about 7 inches thick. The subsurface layer is black, firm silty clay about 28 inches thick. The subsoil is very dark gray and dark gray, mottled, firm silty clay about 16 inches thick. The substratum to a depth of about 60 inches is dark gray, mottled silty clay. In some places the surface layer is silty clay loam. In other places the subsoil contains less clay.

Permeability of the Zook soil is slow, and runoff is slow. The soil has a seasonal high water table. Available water capacity is moderate. The content of organic matter in the surface layer is about 5 to 7 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. If adequately drained, this soil is moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. A drainage system is needed to lower the water table and provide good aeration and a deep root zone for plants. Tile drains generally work satisfactorily only if they are closely spaced and if an adequate outlet is available. Surface drains are needed to remove surface water in some areas. Tilth generally is fair in the surface layer. Returning crop residue to the soil and deferring tillage when the soil is wet help to maintain tilth.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth.

The land capability classification is IIIw.

175D—Dickinson fine sandy loam, 9 to 14 percent slopes. This strongly sloping, well drained and somewhat excessively drained soil is on convex side slopes in uplands and on stream benches. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable fine sandy loam about 5 inches thick. The subsoil is dark yellowish brown and friable and about 26 inches thick. The upper part is sandy loam, and the lower part is loamy sand. The substratum to a depth of about 60 inches is yellowish brown sand. In some places silty or loamy materials are at a depth of 45 inches or more. In other places the soil is steeper.

Permeability of the Dickinson soil is moderately rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is less than 1 percent. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated or are used for hay and pasture. This soil is poorly suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, soil blowing and water erosion are hazards. Stripcropping, a system of conservation tillage that leaves crop residue on the

surface, contour farming, or a combination of these practices helps to prevent excessive soil loss. The soil is droughty in periods of below normal rainfall. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material conserves moisture, improves fertility, and helps to maintain tilth.

On pasture, overgrazing causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

The land capability classification is IVe.

179D—Gara loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on dissected upland side slopes. Areas range from 5 to 30 acres and are long and irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil is firm clay loam about 35 inches thick. The upper part is dark yellowish brown, and the lower part is dark yellowish brown and brown, and mottled. The substratum to a depth of about 60 inches is mottled yellowish brown clay loam. In some places the surface layer is less than 8 inches thick.

Permeability of the Gara soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture, hay, or timber (fig. 7). This soil is poorly suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

179D2—Gara loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex nose slopes and dissected side slopes in uplands. Areas range from 5 to 30 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown clay loam subsoil material into the surface layer. The subsoil is firm clay loam about 35 inches thick. The upper part is dark yellowish brown, and the lower part is dark yellowish brown and mottled. The substratum to a depth of about 60 inches is mottled yellowish brown clay loam. In some places the surface layer is more than 7 inches thick.

Included with this soil in mapping are some small areas of the severely eroded Gara soils. These strongly sloping soils are on short convex side slopes. They make up less than 10 percent of the unit.

Permeability of the Gara soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated, but some are used for hay or pasture. The soil is poorly suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If the soil is used for cultivated crops, further water erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

179E—Gara loam, 14 to 18 percent slopes. This moderately steep, moderately well drained soil is on dissected upland side slopes. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 7 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The

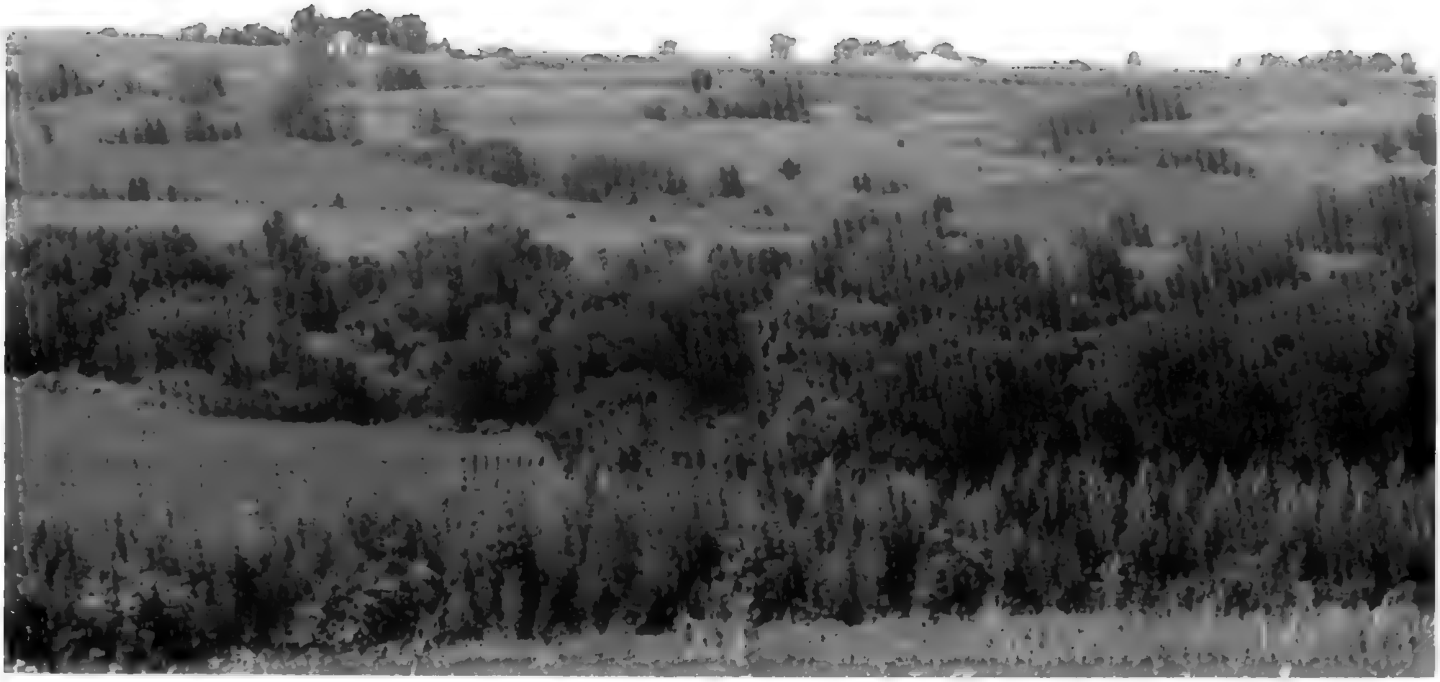


Figure 7.—Trees growing along drainageways in an area of Gara loam, 9 to 14 percent slopes.

subsoil is clay loam about 35 inches thick. The upper part is brown and friable; the next part is dark yellowish brown, mottled, and firm; and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam. In some places the surface layer is less than 7 inches thick.

Permeability of the Gara soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for hay, pasture, or timber. The soil generally is unsuited to corn, soybeans, and small grains mainly because of the erosion hazard. It is moderately suited to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

The land capability classification is VIe.

179E2—Gara loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on dissected upland side slopes. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark brown clay loam subsoil material into the surface layer. The subsoil is firm clay loam about 29 inches thick. The upper part is dark brown, the next part is dark yellowish brown and

mottled, and the lower part is dark yellowish brown and brown, and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam. In some places the surface layer is more than 7 inches thick.

Included with this soil in mapping are some small areas of the severely eroded Gara soils. These moderately steep soils are on short convex side slopes. They make up less than 10 percent of the unit.

Permeability of the Gara soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated, but some are used for hay and pasture. The soil generally is unsuited to corn, soybeans, and small grains and is moderately suited to grasses and legumes for hay and pasture. Good tilth generally can easily be maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIe.

179F—Gara loam, 18 to 25 percent slopes. This steep, moderately well drained soil is on dissected upland side slopes. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 7 inches thick. The subsurface layer is dark grayish brown, friable loam about 3 inches thick. The subsoil is clay loam about 27 inches thick. The upper part is brown and friable; the next part is dark yellowish brown, mottled, and firm; and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is brown, mottled clay loam. In some places the surface layer is less than 7 inches thick.

Permeability of the Gara soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture, hay, or timber. The soil generally is unsuited to corn, soybeans, and small grains mainly because of steepness of slope and the severe hazard of erosion. It is moderately suited to grasses and legumes for hay and pasture. Good tilth generally is easily maintained.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIe.

192D2—Adair clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on convex side slopes in uplands. Areas range from 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark brown clay subsoil material into the surface layer. The subsoil is firm and about 44 inches thick. The upper part is dark brown clay; the next part is dark brown and dark reddish brown, mottled clay; and the lower part is dark yellowish brown and yellowish brown, mottled clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam. A band of pebbles is at the base of the surface layer. The subsoil has some pebbles throughout. In some places the subsoil does not have reddish brown colors and contains less clay.

Included with this soil in mapping are some small areas of Clarinda soils in coves at the head of drainageways above the Adair soil. Clarinda soils have a gray subsoil and are poorly drained. They make up less than 10 percent of the unit.

Permeability of the Adair soil is slow, and runoff is rapid. The soil has a seasonal high water table. Available water capacity is moderate. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are cultivated, but some large areas are in pasture. In most areas the soil is managed together with the adjacent soils. It is poorly suited to corn, soybeans, and small grain, mainly because it is subject to water erosion. Terraces, contour farming, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. The soil is

moderately suited to grasses and legumes for hay and pasture. Tilth generally is fair in the surface layer.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

212—Kennebec silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on flood plains. It is subject to occasional flooding. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is about 36 inches thick. The upper part is very dark brown and very dark grayish brown silt loam, and the lower part is very dark grayish brown and very dark gray silty clay loam. Below this is a transitional layer of very dark gray and very dark grayish brown, mottled, friable silty clay loam about 6 inches thick. The substratum to a depth of about 60 inches is very dark gray silty clay loam. In places about 12 inches of recently deposited silt loam overlies the surface layer.

Included with this soil in mapping are some small areas of the poorly drained Colo soils. These soils are slightly lower on the landscape than the Kennebec soil and dry out more slowly after rains. They make up less than 10 percent of the unit.

Permeability of the Kennebec soil is moderate, and runoff is slow. The soil has a seasonal high water table. Available water capacity is very high. The content of organic matter in the surface layer is about 4 to 6 percent. The substratum generally has a low supply of available phosphorus and a medium supply of available potassium.

Most areas are cultivated. The soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth and prevent surface crusting, improves fertility, and increases the rate of water infiltration.

On pasture, overgrazing causes surface compaction and poor tilth and reduces forage production.

The land capability classification is I.

212+—Kennebec silt loam, overwash, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on flood plains. It is subject to occasional flooding. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is recently deposited alluvium about 12 inches thick. It is very dark grayish brown and dark grayish brown, friable silt loam. Below this, in descending sequence, is about 20 inches of very dark brown, friable silt loam and 8 inches of very dark brown, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is very dark grayish brown and very dark gray, mottled silty clay loam.

Included with this soil in mapping are small areas of the poorly drained, overwashed Colo soils. These soils are slightly lower on the landscape than the Kennebec soil. They make up less than 10 percent of the unit.

Permeability of the Kennebec soil is moderate, and runoff is slow. The soil has a seasonal high water table. Available water capacity is very high. The content of organic matter is about 3 to 5 percent in the surface layer. The substratum generally has a low supply of available phosphorus and a medium supply of available potassium.

Most areas are cultivated. The soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth and prevent surface crusting, improves fertility, and increases the rate of water infiltration.

On pasture, overgrazing causes surface compaction and poor tilth and reduces forage production.

The land capability classification is I.

220—Nodaway silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is in areas of recent deposition on flood plains. It is subject to occasional flooding. Areas generally range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, grayish brown, and very dark grayish brown, stratified silt loam. In places dark silty clay loam is within a depth of 45 inches.

Included with this soil in mapping are some small areas of Kennebec soils on elevations similar to those of the Nodaway soil. Kennebec soils contain more organic matter in the surface layer than the Nodaway soil and are not stratified. They make up less than 10 percent of the unit.

Permeability of the Nodaway soil is moderate, and runoff is slow. The soil has a seasonal high water table. Available water capacity is very high. The content of

organic matter in the surface layer is about 1.5 to 2.5 percent. The substratum generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Wetness is a limitation; it is caused by the flooding and the seasonal high water table. Measures that reduce the wetness also improve the timeliness of fieldwork. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

On pasture, overgrazing reduces forage production.

The land capability classification is IIw.

222C2—Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, poorly drained soil is on short, convex side slopes and in coves at the head of drainageways on uplands. Areas commonly range from 5 to 20 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of gray silty clay subsoil material into the surface layer. The subsoil to a depth of about 60 inches is gray, mottled, and firm. The upper part is silty clay, and the lower part is clay. In some places the subsoil is clay loam at a depth of less than 60 inches.

Included with this soil in mapping are small areas of Colo soils. They are near the center of the mapped areas, on the lower part of the landscape. They contain less clay than the Clarinda soil. They make up less than 10 percent of the unit.

Permeability of the Clarinda soil is very slow, and runoff is medium. Available water capacity is moderate. The soil has a seasonal high water table. Shrink-swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is poorly suited to corn and soybeans. It is best suited to small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, the seasonal high water table is a very serious limitation and further erosion a severe hazard. In row cropped areas, a combination of management practices is needed in controlling erosion. These include a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. In many areas a narrow, seepy band is on the upper part of side slopes. This band commonly remains wet until midsummer. The soil warms slowly in the spring and dries very slowly after rains. Planting is delayed in wet years. Tile drainage is not feasible in this very slowly permeable soil, but installing inceptor tile in the upslope adjacent soils helps to control seepage on this soil.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. Interseeding grasses and legumes into the existing sod helps to prevent excessive soil loss.

The land capability classification is IVw.

222D2—Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, poorly drained soil is on convex side slopes and in coves at the head of drainageways. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, friable silty clay loam about 9 inches thick. Plowing has mixed some streaks and pockets of gray silty clay subsoil material into the surface layer. The subsoil to a depth of about 60 inches is mottled and firm. The upper part is gray silty clay and the lower part is gray clay. In some places the subsoil is clay loam at depths of less than 60 inches.

Included with this soil in mapping are some small areas of the severely eroded Clarinda soils on short convex side slopes. They make up less than 10 percent of the unit.

Permeability of the Clarinda soil is very slow, and runoff is rapid. The soil has a seasonal high water table. Available water capacity is moderate. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorous and potassium.

Most areas are cultivated, but some are in pasture. The soil is poorly suited to corn, soybeans, and small grain. It generally is suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Terraces, contour farming, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. In some areas interceptor tile is needed upslope to help control seepage on this soil. Good tilth generally can be easily

maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

269—Humeston silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is in slightly concave slack water areas on second bottoms. It is subject to occasional flooding. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, friable silt loam about 10 inches thick. The subsurface layer is dark gray, friable silt loam about 6 inches thick. The subsoil to a depth of about 60 inches is very dark gray, black, and dark grayish brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of Colo soils in similar landscape positions. They make up less than 10 percent of the unit.

Permeability of the Humeston soil is moderately slow in the upper part and very slow in the lower part. Runoff is very slow. The soil has a seasonal high water table near or above the surface. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a medium supply of available phosphorous and a very low supply of available potassium.

Most areas are cultivated. If adequately drained, this soil is moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Installing a good drainage system helps to lower the water table and provides good aeration and a deep root zone for plants. Tile drains generally work satisfactorily if they are properly installed and if an adequate outlet is available. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is IIIw.

273B—Olmitz loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on slightly concave to straight foot slopes and alluvial fans at or near the outlet of upland drains. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable loam about 9 inches thick. The subsurface layer is friable loam and clay loam about 22 inches thick. The upper part is black and very dark brown, and the lower part is very dark grayish brown. The subsoil to a depth of about 60 inches is brown and dark yellowish brown, friable and firm clay loam.

Permeability of the Olmitz soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated, but some are used for hay and pasture. This soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. This soil is also subject to overwash from the adjoining steeper slopes. Diversion terraces can be used to reduce overwash from the adjoining higher slopes. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

273C—Olmitz loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on slightly concave to straight foot slopes and alluvial fans at or near the outlets of upland drains. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is black and very dark brown, friable loam and clay loam about 20 inches thick. The subsoil to a depth of about 60 inches is dark brown and brown, friable clay loam.

Permeability of the Olmitz soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated, but some are used for hay and pasture. This soil is moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. This soil is also subject to overwash from the adjoining steeper slopes. Diversion terraces can be used to reduce overwash from the adjoining higher slopes. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

318F2—Clanton silty clay loam, 12 to 20 percent slopes, moderately eroded. This strongly sloping to steep, moderately well drained soil is on the lower part of convex side slopes in uplands. Areas range from 3 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 6 inches thick. Plowing has mixed some streaks and pockets of brown silty clay subsoil material into the surface layer. The subsoil is shale about 27 inches thick. The upper part is brown, mottled, firm silty clay; the middle and lower parts are yellowish red, mottled, very firm clay. The substratum to a depth of about 60 inches is mottled red, light brownish gray, and reddish brown clay. In some places the surface layer is less than 6 inches thick.

Permeability of the Clanton soil is very slow, and runoff is rapid. Available water capacity is moderate. Shrink-swell potential is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are in timber or pasture or are left idle, but a few areas are cultivated. This soil generally is unsuited to corn, soybeans, and small grains and is moderately suited to grasses and legumes for hay and pasture. It is moderately deep over clay shale and is highly susceptible to erosion.

In areas cleared for pasture the hazard of erosion is severe because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Application of fertilizer, weed and brush control, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIIe.

370B—Sharpsburg silty clay loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on ridges in uplands. Areas range from 10 to 80 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is very dark grayish brown and dark brown, friable silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 35 inches thick. The upper part is brown; the next part is brown and mottled; and the lower part is mottled brown, grayish brown, and dark brown. The substratum to a depth of about 60 inches is mottled grayish brown and strong brown silty clay loam.

Permeability of the Sharpsburg soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, terraces, a cropping sequence that includes grasses and legumes, and stripcropping or a combination of these practices helps to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to control erosion, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

370C—Sharpsburg silty clay loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown, friable silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 5 inches thick. The subsoil is friable silty clay loam about 35 inches thick. The upper part is brown and dark yellowish brown, and the lower part is brown and strong brown and mottled. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown silty clay loam. In places the surface layer is less than 7 inches thick.

Permeability of the Sharpsburg soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

370C2—Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on ridges and side slopes in uplands. Areas range from 5 to 30 acres in size and are irregularly shaped or long and narrow.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 35 inches thick. The upper part is dark brown and dark yellowish brown, and the lower part is mottled brown and grayish brown. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown silty clay loam. In some places the surface layer is more than 8 inches thick.

Permeability of the Sharpsburg soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, terraces, a cropping sequence that includes grasses and legumes, and stripcropping or a combination of these practices helps to prevent excessive soil loss. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth, helps to control erosion, and increases the rate of water infiltration. More intense management is needed on this soil than on the less eroded Sharpsburg soils to maintain productivity and improve tilth.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

370D—Sharpsburg silty clay loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on upland side slopes. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown, friable silty clay loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silty clay loam about 5 inches thick. The subsoil is friable silty clay loam about 34 inches thick. The upper part is brown, yellowish brown, and dark yellowish brown; the lower part is mottled brown and grayish brown. The substratum to a depth of about 60 inches is mottled strong brown and brown silty clay loam or silt loam. In places the surface layer may be less than 8 inches thick.

Permeability of this Sharpsburg soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 4 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

370D2—Sharpsburg silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on ridges and side slopes in uplands. Areas range from 5 to 20 acres in size and are irregularly shaped or long and narrow.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 34 inches thick. The upper part is dark brown and dark yellowish brown, and the lower part is mottled brown and grayish brown. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown silty clay loam. In some places the surface layer is more than 8 inches thick.

Permeability of the Sharpsburg soil is moderately slow, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Grassed waterways, a system of conservation tillage that leaves crop residue on the surface, terraces, and a cropping sequence that includes grasses and legumes or a combination of these practices helps to prevent excessive soil loss. Also, in most areas contour farming and stripcropping are practical in controlling erosion. Tilth generally is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth, helps to control erosion, and increases the rate of water infiltration. More intense management is needed on this soil than on the less eroded Sharpsburg soils to maintain productivity and improve tilth.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

423D2—Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on convex shoulders surrounding nearly level upland divides. Areas range from 5 to 20 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark gray, friable silty clay loam about 8 inches thick. It is mixed with some streaks and pockets of dark grayish brown subsoil material. The subsoil is firm and about 38 inches thick. The upper part is dark grayish brown and grayish brown, mottled clay; the lower part is mottled dark brown and light brownish gray clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled clay loam.

Permeability of the Bucknell soil is very slow, and runoff is rapid. Available water capacity is moderate. The soil has a seasonal high water table. Shrink-swell potential also is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is poorly suited to corn and soybeans. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes help to prevent excessive soil

loss. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hay and is well managed. Applications of fertilizer, weed and brush control, rotation, timely deferment of grazing, and proper stocking rates help to keep the pasture in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. Interseeding grasses and legumes into the existing sod helps to prevent excessive soil loss.

The land capability classification is IVe.

430—Ackmore silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on flood plains. It is subject to occasional flooding. Areas generally range from 5 to 50 acres in size, but some are as large as 100 acres. The areas are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The substratum to a depth of about 28 inches is very dark grayish brown, very dark gray, and dark grayish brown, mottled, stratified silt loam. Below this to a depth of about 60 inches is a buried layer of black silty clay loam. In places the soil is silt loam to depths of more than 40 inches.

Included with this soil in mapping are some small areas of the poorly drained, overwashed Colo soils. These soils are lower on the landscape than the Ackmore soil and dry out more slowly after rains. Also, they have a higher organic matter content than the Ackmore soil. They make up less than 10 percent of the unit.

Permeability of the Ackmore soil is moderate, and runoff is slow. The soil has a seasonal high water table. Available water capacity is very high. The content of organic matter in the surface layer is about 1 to 3 percent. The substratum generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system is needed to lower the water table and provide good aeration and a deep root zone for plants. Tile drains work well if they are properly installed and if an adequate outlet is available. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

On pasture, overgrazing reduces forage production.

The land capability classification is IIw.

509—Marshall silty clay loam, benches, 0 to 2 percent slopes. This nearly level, well drained soil is on broad, loess-covered stream benches. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is dark brown, and the lower part is dark brown and yellowish brown and is mottled. The substratum to a depth of about 60 inches is mottled yellowish brown, dark yellowish brown, and grayish brown silty clay loam. In places the loess is underlain by sandy alluvial sediments.

Permeability of the Marshall soil is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3.5 to 4.5 percent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet improve tilth and fertility, help to control erosion and prevent surface crusting, and increase the rate of water infiltration.

The land capability classification is I.

509B—Marshall silty clay loam, benches, 2 to 5 percent slopes. This gently sloping, well drained soil is on broad, loess-covered stream benches. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is black and very dark grayish brown, friable silty clay loam about 9 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is brown, and the lower part is dark brown and yellowish brown and is mottled. The substratum to a depth of about 60 inches is mottled yellowish brown, dark yellowish brown, and grayish brown silty clay loam. In some places the loess is underlain by sandy alluvial sediments.

Permeability of the Marshall soil is moderate, and runoff is slow. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the

surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

509C2—Marshall silty clay loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on the sides of loess-covered stream benches. Areas range from 5 to 25 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 34 inches thick. The upper part is dark brown, and the lower part is brown and yellowish brown and is mottled. The substratum to a depth of about 60 inches is mottled yellowish brown, brown, and grayish brown silty clay loam. In places the surface layer is more than 8 inches thick. In some places the loess is underlain by sandy alluvial sediments.

Permeability of the Marshall soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

517D2—Hesch Variant loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on undulating to strongly sloping uplands. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. Plowing has mixed some streaks and pockets of yellowish red clay loam subsoil material into the surface layer. The subsoil is about 22 inches thick. The upper part is yellowish red, friable clay loam; the next part is yellowish red, mottled, friable loam; and the lower part is strong brown, mottled, friable sandy loam. The substratum to a depth of about 60 inches is multicolored loamy sand and sand. In some places the surface is sandy loam. In other places gravel is on the surface or embedded in sandstone outcroppings.

Permeability of the Hesch soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is rapid. Available water capacity is moderate. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated or are used for hay and pasture. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. Stripcropping, a system of conservation tillage that leaves crop residue on the surface, contour farming, terraces, and crop rotations that include meadow crops or a combination of these practices helps to prevent excessive soil loss. This soil is shallow to sand and is droughty in periods of below normal rainfall. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material helps to conserve moisture, improve fertility, and maintain tilth.

If this soil is used for pasture, overgrazing causes surface compaction and increases the runoff rate.

Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

517E—Hesch Variant loam, 14 to 20 percent slopes. This moderately steep, well drained soil is on undulating to strongly sloping uplands. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark and gray, friable loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable loam about 3 inches thick. The subsoil is about 22 inches thick. The upper part is yellowish red, friable clay loam; the next part is yellowish red, mottled, friable loam; and the lower part is strong brown, mottled, friable sandy loam. The substratum to a depth of about 60 inches is multicolored loamy sand and sand. In some places the surface layer is sandy loam. In other places gravel is on the surface or embedded in the sandstone outcropping.

Permeability of the Hesch soil is moderate, and runoff is rapid. Available water capacity is moderate. The content of organic matter is about 3 to 5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are used for pasture, but a few are cultivated. This soil is poorly suited to corn, soybeans, and small grain and is moderately suited to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. Stripcropping, a system of conservation tillage that leaves crop residue on the surface, contour farming, terraces, and crop rotations that include meadow crops or a combination of these practices helps to prevent excessive soil loss. This soil is shallow to sand and is droughty in periods of below normal rainfall. Returning crop residue to the soil or regularly adding other organic material helps to conserve moisture, improve fertility, and maintain tilth.

On pasture, overgrazing causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

The land capability classification is IVe.

692D2—Mayberry silty clay loam, 5 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on the convex tops of low ridges and on the sides of high terraces that border stream valleys. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark brown clay subsoil material into the surface layer. The subsoil to a depth of about 60 inches is dark brown, mottled, firm clay in the upper part; the next part is dark reddish brown and dark brown, mottled, very firm clay; and the lower part is yellowish brown, mottled, firm clay loam. In some places the surface layer is more than 8 inches thick.

Included with this soil in mapping are small areas of severely eroded soils on summits of convex slopes. They make up less than 10 percent of the unit.

Permeability of the Mayberry soil is slow, and runoff is medium. Available water capacity is moderate. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated, but some are used for pasture. The soil is poorly suited to corn, soybeans, and small grain. It is moderately suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

751D2—Northboro silty clay loam, 5 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on secondary convex ridgetops and convex side slopes. Areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark brown subsoil material into the surface layer. The subsoil to a depth of about 60 inches is dark brown, friable silty clay loam in the upper part; the next part is strong brown, mottled, friable silty clay loam; and the lower part is yellowish brown, mottled, firm clay loam. In

some places the surface layer is more than 8 inches thick.

Included with this soil in mapping are small areas of severely eroded soils. These strongly sloping soils are in similar landscape positions. They make up less than 10 percent of the unit.

Permeability of the Northboro soil is moderately slow, and runoff is medium. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

822D2—Lamoni clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on upland side slopes near the upper end of drainageways. Areas range from 15 to 40 acres in size and are long and narrow.

Typically, the surface layer is very dark brown clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark grayish brown clay subsoil material into the surface layer. The subsoil to a depth of about 60 inches is dark grayish brown, mottled, firm clay in the upper part; the next part is grayish brown, mottled, very firm clay; and the lower part is mottled yellowish brown, grayish brown, and light grayish brown, firm clay loam. In some small places the subsoil is reddish and contains less clay.

Permeability of the Lamoni soil is slow, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and a low to medium supply of potassium.

Most areas are cultivated. This soil is poorly suited to corn, soybeans, and small grain because of the hazard of further water erosion. It is moderately suited to grasses and legumes for hay and pasture. A system of conservation tillage that leaves crop residue on the surface, contour farming, terraces, and a cropping sequence that includes grasses and legumes or a combination of these practices helps to prevent excessive soil loss. Tilth generally is poor in the surface layer.

If this soil is used for pasture, overgrazing or grazing during wet periods causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IVe.

870—Sharpsburg silty clay loam, benches, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on broad, loess-covered stream benches. Areas range from 5 to 30 acres in size and are long and irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsurface layer is dark brown and very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is dark brown, the next part is dark brown and dark yellowish brown and mottled, and the lower part is dark brown and mottled. The substratum to a depth of about 60 inches is brown and dark brown, mottled silty clay loam.

Permeability of the Sharpsburg soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3.5 to 4.5 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated, but some are used for pasture and hay. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and delaying tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking

rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is I.

870B—Sharpsburg silty clay loam, benches, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on broad, loess-covered stream benches. Areas range from 5 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown, friable silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 5 inches thick. The subsoil is friable silty clay loam about 38 inches thick. The upper part is dark brown, the next part is brown and dark yellowish brown and mottled, and the lower part is dark brown and mottled. The substratum to a depth of about 60 inches is dark brown and brown, mottled silty clay loam.

Permeability of the Sharpsburg soil is moderately slow, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated, but some are used for pasture and hay. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and delaying tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

870C2—Sharpsburg silty clay loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on the sides of loess-covered stream benches. Areas range from 5 to 25 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark brown silty clay loam subsoil material into the surface layer. The subsoil is friable silty clay loam about 36 inches thick. The upper part is dark brown, the next part is dark brown and dark yellowish brown and mottled, and the lower part is dark brown and mottled. The substratum to a depth of about 60 inches is dark brown and brown, mottled silty clay loam.

Permeability of the Sharpsburg soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated, but some are used for pasture and hay. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a further hazard. Contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops help to prevent excessive soil loss. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and delaying tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction and poor tilth, increases the runoff rate, and reduces forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

1220—Nodaway silt loam, channeled, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on first bottoms adjacent to meandering streams or curving old stream channels. It is subject to frequent flooding. Areas range from 20 to 100 acres in size and are long and narrow.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum to a depth of about 60 inches is stratified very dark grayish brown silt loam that has thin strata of sand.

Included with this soil in mapping are areas of the poorly drained Colo soils. These soils are in old stream channels and low-lying areas that have not received recent deposits of silty sediment. They make up about 10 percent of the unit.

Permeability of the Nodaway soil is moderate, and runoff is slow. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The substratum generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are used for permanent pasture or woodland. A few areas between old channels are cultivated. Because of the flooding and the numerous old stream channels and oxbows, this soil generally is unsuitable for cultivated crops and hay. It is moderately suited to pasture. Trees should be removed, channels straightened or filled, levees built, and drainage ditches dug before the soil can be cropped. Measures that protect the pasture and trees from floodwater are also needed.

The land capability classification is Vw.

1233—Corley silt loam, benches, 0 to 2 percent slopes. This nearly level, poorly drained soil is in depressional areas on loess-covered stream benches. It is subject to occasional ponding for brief periods. Areas range from 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, friable silt loam about 8 inches thick. The subsurface layer is very dark gray and dark gray, friable silt loam about 11 inches thick. The subsoil is firm silty clay loam about 31 inches thick. The upper part is very dark gray, the next part is gray and dark gray, and the lower part is gray and light brownish gray. The substratum to a depth of about 60 inches is gray silty clay loam. The loess is underlain by alluvial sediments of varying textures.

Included with this soil in mapping are some small areas of the somewhat poorly drained Minden soils. These soils are slightly higher on the landscape than the Corley soil and dry out more rapidly after rains. They make up less than 10 percent of the unit.

Permeability of the Corley soil is moderate, and runoff is very slow or ponded. The soil has a seasonal high water table. Available water capacity is high. The content of organic matter in the surface layer is about 3.5 to 4.5 percent. The subsoil generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It generally is surrounded by a larger area of soils that are adequately drained. A drainage system is needed to lower the water table and provide good aeration and a deep root zone for plants. In many areas, however, deep cuts are needed to provide suitable outlets for tile or surface drains. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is IIw.

1299—Minden silty clay loam, benches, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on loess-covered stream benches. Areas range from 5 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray, friable silty clay loam about 13 inches thick. The subsoil is dark grayish brown and grayish brown, mottled, friable silty clay loam about 28 inches thick. The substratum to a depth of about 60 inches is mottled grayish brown, dark brown, and strong brown silty clay loam. The loess is underlain by alluvial sediments of varying textures. In some places the subsoil is yellowish brown. In other places the surface layer is silt loam.

Included with this soil in mapping are small areas of poorly drained Corley soils. These soils are slightly lower on the landscape than Minden soils and are ponded after rains. They make up less than 10 percent of the unit.

Permeability of the Minden soil is moderate, and runoff is slow. The soil has a seasonal high water table. Available water capacity is very high. The content of organic matter in the surface layer is about 5 to 6 percent. The subsoil generally has a medium supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains generally are not needed but are beneficial in some areas. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is I.

Figure 8.—An inactive limestone quarry.

1368—Macksburg silty clay loam, benches, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on oess-covered stream benches. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsurface layer is black and very dark brown, friable silty clay loam about 15 inches thick. The subsoil is silty clay loam about 37 inches thick. The upper part is very dark grayish brown, mottled, and friable; the next part is dark grayish brown and brown, mottled, and firm; and the lower part is olive gray and light olive gray, mottled, and firm. In places this soil has colors with chroma of less than 2 in the subsoil.

Permeability of this Macksburg soil is moderately slow, and runoff is slow. The soil has a seasonal high water table. Available water capacity is high. The content of organic matter in the surface layer is about 4.5 to 5.5 percent. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains generally are not needed but are beneficial in some areas. Good tilth

generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and prevent surface crusting, improve fertility, and increase the rate of water infiltration.

On pasture, overgrazing or grazing during wet periods causes surface compaction and poor tilth and reduces forage production.

The land capability classification is I.

5010—Pits, sand and gravel. This map unit is dominantly on uplands, but some areas are on bottom lands. Most of the pits are no longer in use, but some are still active. Areas range from 5 to 40 acres in size.

Many areas where sand and gravel have been removed are filled with water. Included in these areas are sandy waste material and stockpiles of sand. Windblown sand is common around the pits. It can be controlled by planting grasses and trees.

Most of the inactive pits support weeds and small trees along the edges. The pits can be developed for use as wildlife habitat or for recreation use. Planting drought-resistant trees and shrubs is needed. Because the soil properties and physical conditions of these soils vary, onsite investigation is needed before any decision can be made about farm or nonfarm uses of specific areas.

A land capability class or subclass has not been assigned.

5030—Pits, limestone quarries. This map unit consists of excavations from which limestone has been removed. Areas range from 10 to 50 acres in size.

The quarries generally have very steep sides made up of limestone or soil material. Some of the inactive ones are full of water (fig. 8).

The spoils surrounding the pits vary in texture, but generally are loamy and contain varying amounts of limestone fragments. In some areas they have been leveled and smoothed, but in other areas they are very uneven. In the leveled areas, grasses or trees grow reasonably well.

Pits, limestone quarries, are not suited to cultivation or grazing unless vegetation is reestablished. Part of the overburden and spoil banks can be leveled and planted to grasses or trees. Soil properties and physical conditions vary; consequently, onsite investigation is needed before any decisions can be made about farm or nonfarm uses of specific areas.

A land capability class or subclass has not been assigned.

5040—Orthents, loamy. This map unit consists of soils that have been leveled, reshaped, or transported during the development of industrial sites and of sites for dwellings and highways. The soils have been so altered that the soil series cannot be identified. In most places the landscape has also been altered. Areas range from 5 to 25 acres in size.

The soil material dominantly is silt loam and silty clay loam. In some areas enough soil material has been removed to expose calcareous silt loam.

Included with these soils in mapping are some areas of fill, where cement, bricks, and trash were covered with soil material, and then compacted and leveled. These areas are used as building sites, railroad yards, and highways.

Erosion is a hazard in the newly cut and filled areas. The soil properties and physical conditions differ from place to place; consequently, onsite investigation is needed before any decisions can be made about farm or nonfarm uses of specific areas.

A capability class or subclass has not been assigned.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water

and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 122,030 acres in the survey area, or more than 45 percent of the total acreage, meets the soil requirements for prime farmland. About 112,000 acres of this land is used for crops. The crops grown on this land, mainly corn and soybeans, account for an estimated two-thirds of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

According to the 1986 Iowa Agricultural Statistics, about 260,800 acres in Montgomery County, or 96 percent of the total acreage, is farmland *(7)*. Of this, about 206,812 acres, about 76 percent of the county, is used for crops. About 38,000 acres, or 14 percent, is used for pasture, and about 9,000 acres is used as woodland. The main crops are corn and soybeans. The major hay crop is legume-grass mixtures. The acreage used for row crops has increased in recent years, whereas the extent of other land uses has been reduced.

Many of the field crops suited to the soils and climate in Montgomery County are not commonly grown. These include sorghum and milo, used mainly for silage; wheat; barley; various pasture grasses; various native grasses, such as bluestem, switchgrass, and indiangrass; sweet corn; nursery stock; early vegetables; and certain orchard crops.

Increased productivity and improved soil conservation will result if the latest crop production technology is applied to all cropland in the county. This soil survey gives the basic characteristics of each kind of soil, and can greatly aid in the application of this technology. The latest information about managing the soils for these crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

The main management needs on the cropland and pasture in Montgomery County are measures for

controlling soil erosion, draining naturally wet soils and seepy areas, and maintaining or improving fertility and tilth.

Water erosion is the major problem on the cropland and pasture in Montgomery County. It is a hazard if the slope is more than 2 percent. Loss of the surface layer through erosion reduces the productivity of soils and results in sedimentation in streams. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a subsoil that is low in fertility, such as Shelby and Gara soils, and on soils that have a clayey subsoil, such as Adair, Lamoni, Bucknell, and Clarinda soils.

The Iowa Erosion Productivity Study has shown corn yields may be reduced an average of 15 bushels per acre because of loss of topsoil on Adair, Lamoni, Bucknell, and Clarinda soils. On eroded soils preparing a good seedbed and tilling are difficult. On these soils the original friable surface layer has been removed or thinned and the more strongly structured subsoil commonly is hard and cloddy after rains or after it has been tilled when wet. Runoff from eroding soils commonly deposits sediment in streams, drainageways, and road ditches. Controlling erosion not only helps to maintain the productivity of soils but also improves the quality of water for municipal use, for recreation, and for fish and wildlife by minimizing the pollution of streams.

Because of the great variety of soils and landscape features, a variety of erosion-control measures is needed in Montgomery County. The best measures provide a protective cover of plants or crop residue, reduce the runoff rate, and increase the rate of water infiltration. Examples of these measures are cover crops, contour stripcropping, contour tillage, terraces, diversions, field borders, grassed waterways, and conservation tillage. Generally, a combination of several measures is most effective.

A cropping system that keeps a plant cover on the surface for extended periods can hold soil losses to an amount that will not reduce the productive capacity of the soils. Soils on steep and very steep slopes are not suitable for row crops and should remain under a protective cover of grasses. On livestock farms, where part of the acreage is hayland or pasture, forage crops of grasses and legumes provide nitrogen and improve tilth for the next cropping season and also cover and protect the surface.

A conservation tillage system that leaves a protective amount of crop residue on the surface after planting is effective in controlling erosion, especially on sloping soils. The major kinds of conservation tillage are as follows. No-till is a system in which the seedbed is prepared and the seed is planted in one operation. The surface is disturbed only in the immediate area of the planted seed rows. A protective cover of crop residue is left undisturbed on the rest of the surface. In strip-till, the seedbed is prepared and the seed planted in one operation. Tillage is limited to a strip not wider than one-third of the row width. A protective cover of crop residue is left on two-thirds of the surface. In mulch-till, the soil is loosened throughout the field and as much as 70 percent of the crop residue is incorporated into the soil. Seedbed preparation and planting can be in one operation, or in several.

Terraces, by reducing the length of slopes, help to reduce runoff and control erosion. They are most effective on well drained or moderately well drained, gently sloping or moderately sloping soils that have smooth slopes, such as Marshall soils. They are less effective in areas where slopes are irregular or too steep. Tile-outlet terraces help to prevent the accumulation of runoff.

In constructing terraces on soils formed in loess, such as Marshall, Exira, and Sharpsburg soils, a special practice is needed: combining these soils with the more slowly permeable adjacent soils, such as Malvern, Adair, Clarinda, and Lamoni soils, should be avoided or minimized. The high content of clay in the more slowly permeable soils limits the design and construction of terraces. It also limits revegetating the terrace slope and may cause a seepage problem following construction.

In building soils in areas of Shelby and other soils that have a subsoil formed partly or entirely in glacial till, the following management practices are suitable. The practices are stockpiling the topsoil when the terraces are constructed and then replacing the topsoil on the exposed subsoil after construction is complete. Diversions commonly are constructed on foot slopes upslope from Olmitz soils. They help to control runoff from adjacent uplands.

Contour farming and contour stripcropping are effective in controlling erosion in Montgomery County. These practices are most effective on soils that have smooth, uniform slopes, such as Marshall, Exira, and Sharpsburg soils. Gully-control structures, grassed waterways, and farm ponds help to control erosion in watercourses. The farm ponds also provide a supply of water for livestock and for recreation.

Information about conservation measures to control soil erosion is available at the Montgomery County Soil Conservation Service office.

Drainage is a major management concern on about

15 percent of the acreage in Montgomery County. Artificial drainage typically is needed on Colo, Humeston, and Zook soils on flood plains and on Bremer and Corley soils on second bottoms.

On poorly drained or very poorly drained soils, artificial drainage generally increases productivity. The drains should be more closely spaced in the moderately slowly permeable soils than in the more rapidly permeable soils. Because of the slow or very slow permeability in Adair, Clarinda, Lamoni, and other soils formed in a paleosol on uplands, seepy areas are common within the surrounding soils. Installing lateral interceptor tile drains upslope from the slowly permeable or very slowly permeable soils helps to intercept and drain the excess water at the point where loess is in contact with the clay textured paleosol.

Fertility is affected by the supply of available phosphorus and potassium in the subsoil, by reaction, and by the content of organic matter in the surface layer. The fertility level varies widely in the soils of Montgomery County. In most of the soils, the supply of available phosphorus and potassium is low or very low and the pH ranges from neutral to strongly acid.

On acid soils, applications of ground limestone are needed to promote good plant growth. On all soils, the kinds and amounts of lime and fertilizer needed should be determined by the results of soil tests, the needs of the crops, and the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime that should be applied.

Tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth generally have a high content of organic matter and are granular and porous. In the uneroded upland soils formed under prairie grasses, such as Sharpsburg and Shelby soils, the content of organic matter in the surface layer is about 3.0 to 4.5 percent. In the eroded upland soils formed under prairie grasses, it is less than 1 to 3 percent, depending on the degree of erosion that has taken place. It also is less than 1 to 3 percent in Gara and Ladoga soils. These soils formed under mixed prairie grasses and deciduous trees. Most of the soils on bottom land have the highest content of organic matter. The content is 4 to 7 percent in the soils on bottom land that have a surface layer of silty clay loam. It is lower in the stratified soils that have a surface layer of silt loam, such as Nodaway soils. Regular additions of crop residue, manure, and other organic material improve soil structure and tilth and help to prevent the formation of a surface crust.

The soils that formed in glacial till, such as Adair, Gara, and Shelby soils, commonly have accumulations of large stones on the surface. These stones can hinder fieldwork unless they are removed.

Most of the permanent pastures in the county support bluegrass. Some have been renovated and support birdsfoot trefoil or crownvetch. Other suitable species common in the pastures are bromegrass, reed canarygrass, orchardgrass, switchgrass, big bluestem, indiangrass, alfalfa, red clover, and ladino clover. Most areas used as bluegrass pasture are not used as cropland because the soils are too steep for cultivation. Measures that prevent overgrazing are needed, especially on steep slopes, to prevent surface compaction and gully erosion. Maximum production of grasses and legumes can be achieved if the pasture is properly managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture in good condition.

Erosion is a severe hazard if the plant cover is destroyed by tillage when the more sloping pastures are renovated. Interseeding the grasses and legumes into the existing sod eliminates the need for destroying the plant cover during seedbed preparation, and prevents soil loss.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity

of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, reduce energy requirements, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and

screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or

maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian olive, autumn olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl-feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and

test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of calcium carbonates affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and

covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of

grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, and bedrock.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to

bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; suscept bility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

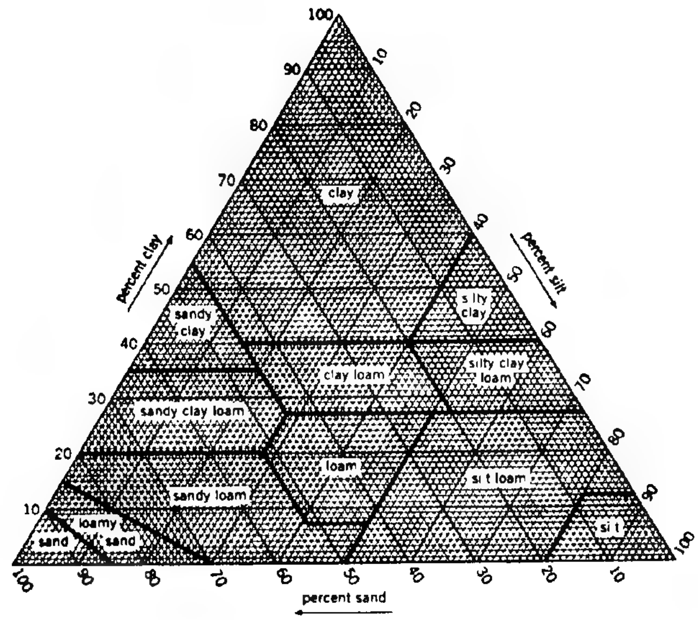


Figure 9.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 9). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified

as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of

water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous, loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist

mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium

content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(15)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludolls (*Hapl*, meaning minimal horizonation, plus *udoll*, the suborder of the Mollisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Hapludolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (14)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (15)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Ackmore Series

The Ackmore series consists of somewhat poorly

drained, moderately permeable soils on flood plains or alluvial fans. These soils formed in recently deposited alluvium over a buried, dark colored alluvium-derived soil. Native vegetation was tall prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Ackmore silt loam, 0 to 2 percent slopes, in a cultivated field; 2,340 feet north and 260 feet west of the southeast corner of sec. 20, T. 71 N., R. 37 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; few fine roots; medium acid; abrupt smooth boundary.

C—9 to 28 inches; stratified very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), and dark grayish brown (10YR 4/2) silt loam; few fine prominent reddish brown (5YR 4/3) mottles; weak thin platy structure; friable; few fine and medium roots; medium acid; clear smooth boundary.

2Ab1—28 to 36 inches; black (10YR 2/1) silty clay loam; weak fine subangular blocky structure; friable; few fine roots; slightly acid; clear smooth boundary.

2Ab2—36 to 47 inches; black (N 2/0) silty clay loam; moderate fine subangular blocky structure; firm; slightly acid; clear smooth boundary.

2Ab3—47 to 60 inches; black (N 2/0) silty clay loam; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; neutral.

The depth to the 2Ab horizon ranges from 20 to 36 inches. The surface layer is 5 to 10 inches thick.

The Ap or A horizon has value of 2 or 3 and chroma of 1 or 2. The C horizon has value of 3 to 5. It is dominantly silt loam, but the range includes silty clay loam. The 2Ab horizon has value of 2 or 3.

Adair Series

The Adair series consists of somewhat poorly drained, slowly permeable soils on convex side slopes in uplands. These soils formed in a paleosol weathered from glacial till. Native vegetation was tall prairie grasses. Slopes range from 9 to 14 percent.

These soils are taxadjuncts to the Adair series because the surface layer is not thick enough to qualify as a mollic epipedon.

Typical pedon of Adair clay loam, 9 to 14 percent slopes, moderately eroded, in a cultivated field; 1,720 feet west and 360 feet north of the southeast corner of sec. 7, T. 73 N., R. 36 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; mixed with some streaks and pockets of dark brown (7.5YR 4/4) clay subsoil material; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

2Bt1—8 to 15 inches; dark brown (7.5YR 4/4) clay; weak fine subangular blocky structure; firm; few faint clay films on faces of peds; few fine pebbles; medium acid; clear smooth boundary.

2Bt2—15 to 22 inches; dark brown (7.5YR 4/4) clay; common fine distinct dark grayish brown (10YR 4/2) and common fine distinct dark reddish brown (5YR 3/4) mottles; weak medium subangular blocky structure; firm; common faint clay films on faces of peds; common dark concretions (iron and manganese oxides); few fine pebbles; medium acid; clear smooth boundary.

2Bt3—22 to 31 inches; dark brown (7.5YR 4/4) and dark reddish brown (5YR 3/4) clay; common fine distinct dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; firm; common faint clay films on faces of peds; common dark concretions (iron and manganese oxides); few fine pebbles; medium acid; clear smooth boundary.

2Bt4—31 to 45 inches; dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); common fine and medium pebbles; medium acid; clear smooth boundary.

2BC—45 to 52 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct grayish brown (10YR 5/2) and few fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak fine subangular blocky; firm; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); common fine and medium pebbles; medium acid; clear smooth boundary.

2C—52 to 60 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct grayish brown (10YR 5/2) and few fine distinct strong brown (7.5YR 5/6) mottles; massive; firm; common fine and medium pebbles; medium acid.

The solum ranges from 40 to 60 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly clay loam, but the range includes silty clay loam, loam, and silt loam. The 2Bt horizon has value of 3 to 5 and chroma of 4 to 6. The 2C horizon has value of 4 or 5 and chroma of 4 to 6.

Bremer Series

The Bremer series consists of poorly drained, moderately slowly permeable soils on second bottoms. These soils formed in alluvium. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Bremer silty clay loam, 0 to 2 percent slopes, in a cultivated field; 200 feet east and 2,100 feet south of the northwest corner of sec. 4, T. 72 N., R. 36 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; medium acid; gradual smooth boundary.

A—8 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

Bt—17 to 27 inches; very dark gray (10YR 3/1) silty clay loam; few fine distinct dark brown (7.5YR 3/2) and few fine faint grayish brown (2.5Y 5/2) mottles; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; medium acid; gradual smooth boundary.

Btg—27 to 39 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few fine faint olive brown (2.5Y 4/4) and common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to weak fine subangular blocky; firm; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

BCg—39 to 48 inches; gray (5Y 5/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) and few fine faint light brownish gray (2.5Y 6/2) mottles; weak fine prismatic structure; firm; few faint clay films in root channels; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Cg—48 to 60 inches; gray (5Y 5/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) and few fine faint light brownish gray (2.5Y 6/2) mottles; massive; few dark concretions (iron and manganese oxides); slightly acid.

The solum ranges from 40 to 60 inches in thickness. The depth to free carbonates is more than 60 inches. The mollic epipedon ranges from 24 to 36 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 0 or 1. The Bt horizon has value of 3 to 5 and chroma of 0 to 2. It is dominantly silty clay loam, but the range includes silty clay. The C horizon has value of 4 or 5.

Bucknell Series

The Bucknell series consists of somewhat poorly drained, very slowly permeable soils on convex shoulders surrounding nearly level upland divides. These soils formed in a truncated paleosol weathered from glacial till. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 9 to 14 percent.

Typical pedon of Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded, in an alfalfa field; 1,690 feet west and 195 feet south of the northeast corner of sec. 11, T. 73 N., R. 36 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of dark grayish brown (10YR 4/2) clay subsoil material; weak fine granular structure; friable; few fine roots; slightly acid; clear smooth boundary.

Bt1—8 to 15 inches; dark grayish brown (10YR 4/2) clay; few fine faint grayish brown (2.5Y 5/2) mottles; weak fine subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—15 to 25 inches; grayish brown (2.5Y 5/2) clay; common fine prominent strong brown (7.5YR 5/6) and few fine faint light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common faint clay films on faces of peds; few fine white sand grains; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt3—25 to 37 inches; mottled dark brown (7.5YR 4/4) and light brownish gray (2.5Y 6/2) clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common faint clay films on faces of peds; few fine white sand grains; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

BC—37 to 46 inches; light brownish gray (2.5Y 6/2) clay loam; common fine prominent dark brown (7.5YR 4/4) and few fine faint grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common faint clay films on faces of peds; few fine white sand grains; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

C—46 to 60 inches; light brownish gray (2.5Y 6/2) clay

loam; many medium prominent dark brown (7.5YR 4/4) and few fine distinct strong brown (7.5YR 5/8) mottles; massive; firm; few dark concretions (iron and manganese oxides); medium acid.

The solum ranges from 40 to 60 inches in thickness. The mollic colors range from 6 to 10 inches in thickness.

The Ap or A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes clay loam and loam. Some pedons have an E horizon that has value of 4 or 5 and chroma of 2 or 3. It is dominantly silt loam, but the range includes silty clay loam. The Bt horizon has value of 4 to 6 and chroma of 1 to 4. The C horizon has value of 4 to 7 and chroma of 1 to 6.

Clanton Series

The Clanton series consists of moderately well drained, very slowly permeable soils on uplands. These soils formed in residuum weathered from reddish, acid shale and are mantled with silty or loamy materials. Native vegetation was mixed grasses and trees. Slopes range from 12 to 20 percent.

These soils are taxadjuncts to the Clanton series because the subsoil and substratum are more acid than the series allows.

Typical pedon of Clanton silty clay loam, 12 to 20 percent slopes, moderately eroded, in a cultivated field; 120 feet east and 500 feet north of the southwest corner of sec. 17, T. 73 N., R. 36 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; mixed with some streaks and pockets of brown (10YR 5/3) silty clay subsoil material; weak fine granular structure; friable; very strongly acid; clear smooth boundary.

Bt1—6 to 14 inches; brown (10YR 5/3) silty clay; few fine prominent red (2.5YR 4/6) mottles; weak medium subangular blocky structure; very firm; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—14 to 25 inches; yellowish red (5YR 4/6) clay; few fine distinct red (2.5YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; few faint clay films on faces of peds; few fine concretions (iron and manganese oxides); very strongly acid; gradual smooth boundary.

Bt3—25 to 33 inches; yellowish red (5YR 4/6) clay; few fine distinct light olive brown (2.5Y 5/4) and dark red (2.5YR 3/6) mottles; weak medium prismatic structure; very firm; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); extremely acid; gradual smooth boundary.

Cr1—33 to 42 inches; red (2.5YR 4/6) soft shale bedrock that has texture of clay; few fine distinct light brownish gray (2.5Y 6/2) and reddish brown (2.5YR 5/4) mottles; massive; very firm; extremely acid; gradual smooth boundary.

Cr2—42 to 60 inches; mottled red (2.5YR 4/6), light brownish gray (2.5Y 6/2), and reddish brown (2.5YR 5/4) soft shale bedrock that has texture of clay; massive; very firm; extremely acid.

The solum ranges from 30 to 50 inches in thickness. The mollic colors range from 6 to 10 inches in thickness.

The Ap or A horizon has chroma of 1 or 2. It is dominantly silty clay loam, but the range includes loam, silt loam, and clay loam. The Bt horizon has value of 3 to 5 and chroma of 3 to 6. It is dominantly clay, but the range includes silty clay and silty clay loam and averages between 38 and 48 percent clay. The Cr horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 1 to 8. It is dominantly soft shale bedrock that has texture of clay or silty clay.

Clarinda Series

The Clarinda series consists of poorly drained, very slowly permeable soils on convex side slopes and heads of drainageways in uplands. These soils formed in a gray, clayey paleosol weathered from glacial till. Native vegetation was tall prairie grasses. Slopes range from 5 to 14 percent.

These soils are taxadjuncts to the Clarinda series because the surface layer is not thick enough to qualify as a mollic epipedon.

Typical pedon of Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded, in a hayfield; 980 feet west and 100 feet south of the northeast corner of sec. 30, T. 71 N., R. 37 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; mixed with some streaks and pockets of gray (5Y 5/1) silty clay subsoil material; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

2Btg1—9 to 17 inches; gray (5Y 5/1) silty clay; very dark gray (10YR 3/1) coatings on faces of peds; few fine prominent strong brown (7.5YR 5/6) mottles;

weak fine subangular blocky structure; firm; common fine roots; few distinct clay films on faces of peds; few dark accumulations (iron and manganese oxides); medium acid; clear smooth boundary.

2Btg2—17 to 35 inches; gray (5Y 5/1) clay; few fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; common fine roots; few distinct clay films on faces of peds; few very dark gray (10YR 3/1) organic fills in root channels; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

2Btg3—35 to 50 inches; gray (10YR 6/1) clay; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few distinct clay films on faces of peds; few dark concretions (iron and manganese oxides); few soft accumulations (calcium carbonates); mildly alkaline; gradual smooth boundary.

2Btg4—50 to 60 inches; gray (10YR 6/1) clay; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine prismatic structure parting to weak medium subangular blocky; firm; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); few soft accumulations (calcium carbonates); mildly alkaline.

The solum ranges from 50 to more than 60 inches in thickness. The A horizon typically formed in loess or silty sediments 8 to 18 inches thick. The Ap horizon ranges from 8 to 10 inches in thickness.

The A horizon has value of 2 or 3. The 2Btg horizon has value of 4 to 6. It is silty clay loam or silty clay in the upper part and silty clay or clay in the lower part.

Colo Series

The Colo series consists of poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Native vegetation was tall prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, in a cultivated field; 60 feet east and 850 feet north of the southwest corner of sec. 32, T. 73 N., R. 39 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A1—8 to 16 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; slightly acid; gradual smooth boundary.

A2—16 to 25 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; slightly acid; gradual smooth boundary.

A3—25 to 32 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine roots; neutral; gradual smooth boundary.

Bg—32 to 43 inches; very dark gray (10YR 3/1) silty clay loam; few fine faint dark grayish brown (10YR 4/2) and few fine distinct dark brown (7.5YR 4/4) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; few fine roots; neutral; gradual smooth boundary.

Cg1—43 to 52 inches; very dark gray (10YR 3/1) silty clay loam; few fine faint dark grayish brown (10YR 4/2) and common fine distinct dark brown (7.5YR 4/4) mottles; massive; friable; few fine roots; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Cg2—52 to 60 inches; very dark gray (10YR 3/1) silty clay loam; few fine faint dark grayish brown (10YR 4/2) and common fine distinct dark brown (7.5YR 4/4) mottles; massive; friable; few fine roots; few dark concretions (iron and manganese oxides); slightly acid.

The A horizon ranges from 30 to 40 inches thick. It is dominantly silty clay loam, but the range includes silt loam. It has value of 2 to 3 and chroma of 0 to 2. The Bg horizon has value of 2 or 3 and chroma of 0 or 1. The Cg horizon has value of 2 to 5 and chroma of 1 or 2. The Bg and Cg horizons average between 30 and 35 percent clay, but the range includes horizons that are 36 to 40 percent clay.

Corley Series

The Corley series consists of poorly drained, moderately permeable soils in depressions on high stream benches. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Corley silt loam, benches, 0 to 2 percent slopes, in a cultivated field; 2,320 feet north and 100 feet east of the southwest corner of sec. 10, T. 72 N., R. 36 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; few fine pores; slightly acid; clear smooth boundary.

A—8 to 13 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few fine pores; few fine distinct brown (7.5YR 5/2) stains on some faces of peds; medium acid; clear smooth boundary.

E—13 to 19 inches; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; weak thin platy structure parting to weak fine subangular blocky; friable; few fine pores; grayish brown (10YR 5/2) silt coatings on some faces of peds; medium acid; clear smooth boundary.

Bt—19 to 30 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium subangular blocky structure; firm; few fine pores; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Btg—30 to 40 inches; gray (5Y 5/1) and dark gray (5Y 4/1) silty clay loam; moderate medium subangular blocky structure; firm; few fine pores; few faint clay films on faces of peds; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

BCg—40 to 50 inches; dark gray (5Y 4/1) and light brownish gray (2.5Y 6/2) silty clay loam; weak medium prismatic structure parting to weak medium subangular blocky; firm; few fine pores; common medium prominent dark brown (7.5YR 4/4) iron stains on some faces of peds; black (N 2/0) stains in some root channels; medium acid.

Cg—50 to 60 inches; gray (5Y 6/1) silty clay loam; massive; firm; common medium prominent strong brown (7.5YR 5/6) iron stains on some faces of peds; black (N 2/0) stains in some root channels; medium acid.

The solum ranges from 40 to 60 inches in thickness. The mollic epipedon ranges from 13 to 24 inches in thickness.

The A horizon has value of 2 or 3. The Btg horizon has value of 2 to 5 and chroma of 0 to 2. The Cg horizon has value of 5 or 6 and chroma of 1 or 2.

Dickinson Series

The Dickinson series consists of somewhat excessively drained, moderately rapidly permeable soils on uplands and stream benches. These soils formed in glacial or alluvial deposits that have been reworked by wind. Native vegetation was tall prairie grasses. Slopes range from 9 to 14 percent.

Typical pedon of Dickinson fine sandy loam, 9 to 14 percent slopes, in a pasture; 280 feet east and 100 feet north of the southwest corner of sec. 27, T. 71 N., R. 36 W.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A2—7 to 12 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; slightly acid; gradual smooth boundary.

Bw1—12 to 24 inches; dark yellowish brown (10YR 4/4) sandy loam; brown (10YR 4/3) coatings on faces of peds; weak fine and medium subangular blocky structure; friable; few fine roots; medium acid; gradual smooth boundary.

Bw2—24 to 31 inches; dark yellowish brown (10YR 4/4) sandy loam; brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

BC—31 to 38 inches; yellowish brown (10YR 5/6) loamy sand; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

C—38 to 60 inches; yellowish brown (10YR 5/6) sand; single grain; friable; medium acid.

The solum ranges from 24 to 50 inches in thickness. The mollic epipedon ranges from 12 to 20 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 to 3. It is dominantly fine sandy loam, but the range includes loam and sandy loam. The Bw horizon has value of 3 to 5 and chroma of 2 to 6. It is dominantly sandy loam, but the range includes fine sandy loam. The C horizon has value of 4 or 5 and chroma of 3 to 6. It is dominantly sand, but the range includes loamy fine sand, loamy sand, and fine sand. Some pedons have silty or loamy materials within depths of 45 inches.

Exira Series

The Exira series consists of well drained, moderately permeable soils on uplands. These soils formed in

loess. Native vegetation was tall prairie grasses. Slopes range from 5 to 18 percent.

These soils are taxadjuncts to the Exira series because the surface layer is not thick enough to qualify as a mollic epipedon.

Typical pedon of Exira silty clay loam, 9 to 14 percent slopes, moderately eroded, in an alfalfa field; 140 feet east and 400 feet south of the northwest corner of sec. 20, T. 73 N., R. 39 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; mixed with some streaks and pockets of brown (10YR 4/3) silty clay loam subsoil material; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

Bw1—9 to 18 inches; brown (10YR 4/3) silty clay loam; dark brown (10YR 3/3) coatings on faces of peds; weak fine subangular blocky structure; friable; common fine roots; slightly acid; gradual smooth boundary.

Bw2—18 to 25 inches; dark yellowish brown (10YR 4/4) silty clay loam; brown (10YR 4/3) coatings on faces of some peds; few fine distinct brown (7.5YR 4/4), strong brown (7.5YR 5/6), and light brownish gray (2.5Y 6/2) mottles; weak fine subangular blocky structure; friable; common fine roots; slightly acid; gradual smooth boundary.

Bw3—25 to 31 inches; brown (10YR 5/3) silty clay loam; light olive brown (2.5Y 5/4) coatings on faces of peds; common fine distinct dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots; slightly acid; gradual smooth boundary.

BC—31 to 41 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine prominent dark brown (7.5YR 4/4) and strong brown (7.5YR 4/6) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; few fine roots; slightly acid; gradual smooth boundary.

C1—41 to 51 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine and medium prominent dark brown (7.5YR 4/4) and strong brown (7.5YR 4/6) mottles; massive; friable; few fine roots; few dark concretions (iron and manganese oxides); few soft accumulations (calcium carbonates); slight effervescence; neutral; gradual smooth boundary.

C2—51 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine and medium prominent dark brown (7.5YR 4/4) and strong brown (7.5YR 4/6) mottles; massive; friable; few fine roots; few dark concretions (iron and manganese oxides); common soft accumulations (calcium carbonates); slight effervescence; neutral.

The solum ranges from 30 to 50 inches in thickness. The depth to carbonates is 40 or more inches. The dark Ap horizon ranges from 6 to 10 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has value of 3 to 5 and chroma of 2 to 4. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is dominantly silty clay loam, but the range includes silt loam.

Gara Series

The Gara series consists of moderately well drained, moderately slowly permeable soils on dissected side slopes. These soils formed in glacial till. Native vegetation was tall prairie grasses and deciduous trees. Slopes range from 9 to 25 percent.

Typical pedon of Gara loam, 14 to 18 percent slopes, in timber-pasture; 2,020 feet west and 600 feet south of the northeast corner of sec. 3, T. 71 N., R. 36 W.

A—0 to 7 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

E—7 to 11 inches; dark grayish brown (10YR 4/2) loam, gray (10YR 5/1) and light gray (10YR 6/1) dry; weak medium platy structure parting to weak fine subangular blocky; friable; few fine roots; medium acid; clear smooth boundary.

BE—11 to 15 inches; brown (10YR 5/3) clay loam; moderate fine and medium subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

Bt1—15 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; firm; few fine roots; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); strongly acid; clear smooth boundary.

Bt2—24 to 37 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct strong brown (7.5YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; firm; many faint clay films on faces of peds; few dark concretions (iron and manganese oxides); very strongly acid; clear smooth boundary.

BC—37 to 46 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct strong brown (7.5YR 5/6) and common fine faint grayish brown (10YR 5/2) and gray (10YR 6/1) mottles; weak fine prismatic structure parting to moderate fine and medium subangular blocky; firm; few dark concretions (iron and manganese oxides); few soft accumulations (calcium carbonates); strong effervescence; mildly alkaline; clear smooth boundary.

C—46 to 60 inches; yellowish brown (10YR 5/6) clay loam; common fine and medium distinct strong brown (7.5YR 4/6) mottles; massive; firm; few dark concretions (iron and manganese oxides); few soft accumulations (calcium carbonates); strong effervescence; moderately alkaline.

The solum thickness and the depth to free carbonates range from 36 to 60 inches or more. The mollic color ranges from 6 to 9 inches in thickness.

The A horizon has chroma of 1 or 2. It is dominantly loam, but the range includes clay loam and silt loam. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. The C horizon has value of 4 or 5 and chroma of 4 to 6.

Hesch Variant

The Hesch Variant consists of well drained soils on uplands. These soils formed in loamy and sandy sediments. Permeability is moderate in the upper part of the profile and rapid in the lower part. Native vegetation was mixed grasses and trees. Slopes range from 9 to 20 percent.

Typical pedon of Hesch Variant loam, 9 to 14 percent slopes, moderately eroded, in a cultivated field; 2,000 feet west and 200 feet south of the northeast corner of sec. 30, T. 71 N., R. 38 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, dark brown (7.5YR 4/2) dry; mixed with streaks and pockets of yellowish red (5YR 4/6) clay loam subsoil material; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

Bt1—7 to 14 inches; yellowish red (5YR 4/6) clay loam; weak fine and very fine subangular blocky structure; friable; few faint clay films on faces of peds; few fine pebbles; slightly acid; clear smooth boundary.

Bt2—14 to 22 inches; yellowish red (5YR 4/6) loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; few faint clay films on faces of peds; few medium pebbles; slightly acid; clear smooth boundary.

BC—22 to 29 inches; strong brown (7.5YR 5/6) sandy loam; weak very fine subangular blocky structure parting to weak fine granular; friable; common medium pebbles; slightly acid; clear smooth boundary.

C1—29 to 38 inches; strong brown (7.5YR 5/6) loamy sand; single grain; loose; many medium pebbles; 1-inch band of strong brown (7.5YR 5/6) sandy loam at 35 inches; slightly acid; clear smooth boundary.

C2—38 to 46 inches; strong brown (7.5YR 5/6) sand; single grain; loose; many fine and few medium pebbles; slightly acid; clear smooth boundary.

C3—46 to 60 inches; strong brown (7.5YR 5/6) sand; single grain; loose; common fine and few medium pebbles; slightly acid.

The solum ranges from 20 to 40 inches in thickness. The mollic colors range from 7 to 10 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 to 3. It is dominantly loam, but the range includes sandy loam and fine sandy loam. The Bt horizon has value of 3 or 4 and chroma of 3 to 6. It is dominantly loam or clay loam, but the range includes sandy loam. The C horizon has value of 4 to 6 and chroma of 3 to 8.

Humeston Series

The Humeston series consists of poorly drained, very slowly permeable soils in slightly concave slack water areas of bottom land. These soils formed in alluvium. Native vegetation was tall prairie grasses and deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Humeston silt loam, 0 to 2 percent slopes, in a cultivated field; 900 feet east and 380 feet north of the southwest corner of sec. 8, T. 72 N., R. 38 W.

A—0 to 10 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots; medium acid; clear smooth boundary.

E—10 to 16 inches; dark gray (10YR 4/1) silt loam, light gray (10YR 6/1) and light brownish gray (10YR 6/2) dry; weak thin platy structure; friable; common fine roots; medium acid; clear smooth boundary.

BE—16 to 20 inches; very dark gray (10YR 3/1) silty clay loam (about 30 percent clay); weak fine subangular blocky structure; friable; common fine

roots; few light gray (10YR 7/1) silt coatings on faces of peds; slightly acid; clear smooth boundary.

Bt1—20 to 34 inches; black (10YR 2/1) silty clay loam (about 38 percent clay); weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—34 to 46 inches; very dark gray (10YR 3/1) silty clay loam (about 38 percent clay); few fine faint dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) mottles; moderate medium prismatic structure; firm; few fine roots; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

BC—46 to 60 inches; dark grayish brown (10YR 4/2) silty clay loam; few dark gray (10YR 4/1) coatings on faces of peds; weak medium prismatic structure; firm; few very dark gray (10YR 3/1) fills in old root channels; common dark concretions (iron and manganese oxides); slightly acid.

The solum is 60 inches or more in thickness. The mollic epipedon ranges from 10 to 16 inches in thickness.

The A horizon has value of 2 or 3. It is dominantly silt loam, but the range includes silty clay loam. The E horizon has value of 4 or 5. The Bt horizon has value of 2 or 3 and chroma of 0 or 1. It is dominantly silty clay loam, but the range includes silty clay.

Judson Series

The Judson series consists of well drained, moderately permeable soils on foot slopes and alluvial fans. These soils formed in local alluvium. Native vegetation was tall prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Judson silty clay loam, 2 to 5 percent slopes, in a cultivated field; 700 feet east and 100 feet south of the northwest corner of sec. 3, T. 37 N., R. 39 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.

A1—9 to 17 inches; black (10YR 2/1) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak very fine subangular blocky structure; friable; few fine roots; slightly acid; gradual smooth boundary.

A2—17 to 26 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; friable; few fine roots; slightly acid; gradual smooth boundary.

BA—26 to 32 inches; dark brown (10YR 3/3) silty clay loam; very dark grayish brown (10YR 3/2) coatings on faces of some peds; moderate fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

Bw—32 to 42 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; friable; few faint clay films on faces of peds; medium acid; gradual smooth boundary.

BC—42 to 50 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; few faint clay films on faces of peds; medium acid; gradual smooth boundary.

C—50 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; massive; friable; slightly acid.

The solum ranges from 40 to 60 inches in thickness. The depth to carbonates is more than 60 inches. The mollic epipedon ranges from 24 to 34 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silt loam. The Bw horizon has value and chroma of 3 or 4. It averages between 30 and 35 percent clay.

Kennebec Series

The Kennebec series consists of moderately well drained, moderately permeable soils on flood plains. These soils formed in alluvium. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Kennebec silt loam, 0 to 2 percent slopes, in a cultivated field; 240 feet east and 2,500 feet north of the southwest corner of sec. 24, T. 72 N., R. 36 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A1—8 to 19 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A2—19 to 28 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; very dark grayish brown (10YR 3/2) coatings on faces of

peds; weak fine and medium subangular blocky structure; friable; medium acid; clear smooth boundary.

A3—28 to 36 inches; very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) silt loam; weak fine and medium subangular blocky structure; friable; medium acid; clear smooth boundary.

A4—36 to 44 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silty clay loam; few fine faint dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure; friable; few dark concretions (iron and manganese oxides); medium acid; diffuse smooth boundary.

AC—44 to 50 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silty clay loam; few fine faint dark brown (10YR 3/3) mottles; weak medium subangular blocky structure; friable; few dark concretions (iron and manganese oxides); medium acid; diffuse smooth boundary.

C—50 to 60 inches; very dark gray (10YR 3/1) silty clay loam; massive; friable; few dark concretions (iron and manganese oxides); slightly acid.

The solum and the mollic epipedon are more than 36 inches thick. The depth to free carbonates is more than 60 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2, but, on overwash phases, the range includes value of 4. The C horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam or silty clay loam.

Ladoga Series

The Ladoga series consists of moderately well drained, moderately slowly permeable soils on convex summits of interfluves and side slopes in uplands. These soils formed in loess. Native vegetation was tall prairie grasses and deciduous trees. Slopes range from 2 to 14 percent.

Typical pedon of Ladoga silt loam, 9 to 14 percent slopes, moderately eroded, in a pasture; 260 feet west and 2,560 feet south of the northeast corner of sec. 20, T. 73 N., R. 36 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; some mixing of dark yellowish brown (10YR 4/4) silty clay loam subsoil material; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

Bt1—9 to 19 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine subangular blocky structure; friable; few fine roots; few faint clay films on faces of some peds; medium acid; gradual smooth boundary.

Bt2—19 to 26 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine angular blocky structure; firm; few fine roots; few faint clay films and brownish gray (10YR 6/2) silt coatings on faces of peds; medium acid; gradual smooth boundary.

Bt3—26 to 34 inches; yellowish brown (10YR 5/4) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; few fine roots; few faint clay films and light brownish gray (10YR 6/2) silt coatings on faces of peds; few dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt4—34 to 45 inches; yellowish brown (10YR 5/4) silty clay loam; common fine faint grayish brown (10YR 5/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine roots; few faint clay films on faces of some peds; few dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

BC—45 to 54 inches; mottled grayish brown (10YR 5/2), yellowish brown (10YR 5/4), and strong brown (7.5YR 5/6) silty clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

C—54 to 60 inches; grayish brown (10YR 5/2) silty clay loam; few fine faint brown (10YR 5/3) and few fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; few dark concretions (iron and manganese oxides); strongly acid.

The solum ranges from 36 to 60 inches or more in thickness. The mollic colors range from 6 to 9 inches in thickness.

The Ap or A horizon has value of 2 or 3 and chroma of 1 or 2. Some pedons have an E horizon that has value of 4 or 5. The Bt horizon has value of 4 or 5 and chroma of 2 to 4. It is dominantly silty clay loam, but the range includes silty clay. The C horizon has value of 4 or 5 and chroma of 2 to 4.

Lamoni Series

The Lamoni series consists of somewhat poorly drained, slowly permeable soils on convex side slopes surrounding the nearly level, stable, upland divides.

These soils formed in a partly truncated paleosol weathered from glacial till. Native vegetation was tall prairie grasses. Slopes range from 9 to 14 percent.

These soils are taxadjuncts to the Lamoni series because the surface layer is not thick enough to qualify as a mollic epipedon.

Typical pedon of Lamoni clay loam, 9 to 14 percent slopes, moderately eroded, in pasture; 2,030 feet east and 160 feet north of the southwest corner of sec. 22, T. 71 N., R. 37 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) clay loam, dark grayish brown (10YR 4/2) dry; very dark gray (10YR 3/1) coatings on faces of some peds; some mixing of dark grayish brown (10YR 4/2) clay subsoil material; weak fine granular structure; friable; common fine roots; medium acid; clear smooth boundary.

2Bt1—8 to 13 inches; dark grayish brown (10YR 4/2) clay; very dark brown (10YR 2/2) coatings on faces of some peds; common fine distinct olive brown (2.5Y 4/4) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

2Bt2—13 to 23 inches; grayish brown (2.5Y 5/2) clay; few fine faint olive brown (2.5Y 4/4) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very firm; few fine roots; few faint clay films on faces of peds; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

2Bt3—23 to 31 inches; grayish brown (2.5Y 5/2) clay; few fine distinct strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; weak fine prismatic structure; very firm; few fine roots; few faint clay films on faces of peds; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

2Bt4—31 to 40 inches; grayish brown (2.5Y 5/2) clay loam; few fine faint light brownish gray (2.5Y 6/2) and common fine distinct strong brown (7.5YR 5/8) mottles; moderate fine prismatic structure; firm; many faint clay films on faces of peds; common fine dark concretions (iron and manganese oxides); few soft accumulations (calcium carbonates); neutral; gradual smooth boundary.

2BC—40 to 60 inches; mottled yellowish brown (10YR 5/6), grayish brown (2.5Y 5/2), and light brownish gray (2.5Y 6/2) clay loam; weak medium prismatic structure parting to weak fine and medium subangular blocky; firm; common fine dark concretions (iron and manganese oxides); few fine soft accumulations (calcium carbonates); neutral.

The solum ranges from 48 to 60 inches or more in thickness. The dark Ap horizon ranges from 8 to 10 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly clay loam, but the range includes loam and silty clay loam. The 2Bt horizon has value of 4 to 6 and chroma of 1 to 6. The BC horizon has value of 5 or 6 and chroma of 1 to 6.

Macksburg Series

The Macksburg series consists of somewhat poorly drained, moderately slowly permeable soils on high stream benches. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Macksburg silty clay loam, benches, 0 to 2 percent slopes, in a cultivated field; 1,200 feet west and 1,300 feet south of the northeast corner of sec. 14, T. 71 N., R. 36 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; few fine roots; slightly acid; clear smooth boundary.

A1—8 to 16 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; slightly acid; clear smooth boundary.

A2—16 to 23 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few fine roots; slightly acid; clear smooth boundary.

BA—23 to 28 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine faint dark grayish brown (10YR 4/2) and brown (10YR 4/3) mottles; weak fine subangular blocky structure; friable; few fine roots; medium acid; clear smooth boundary

Bt1—28 to 43 inches; dark grayish brown (10YR 4/2) and brown (10YR 5/3) silty clay loam; few fine distinct strong brown (7.5YR 5/6) and dark grayish brown (2.5Y 4/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; few distinct clay films on faces of peds; few dark concretions

(iron and manganese oxides); medium acid; gradual smooth boundary.

Bt2—43 to 60 inches; olive gray (5Y 5/2) and light olive gray (5Y 6/2) silty clay loam; common medium prominent dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; firm; few fine roots; few distinct clay films on faces of peds; few dark concretions (iron and manganese oxides); medium acid.

The solum ranges from 48 to 60 inches or more in thickness. The mollic epipedon ranges from 16 to 28 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silt loam. The Bt horizon has value of 4 or 5 and chroma of 2 to 4. It is dominantly silty clay loam, but the range includes silty clay with a clay maximum between 36 and 42 percent.

Malvern Series

The Malvern series consists of somewhat poorly drained, slowly permeable soils on convex side slopes in uplands. These soils formed in Loveland loess and the underlying paleosol weathered from loess. Native vegetation was tall prairie grasses. Slopes range from 9 to 14 percent.

These soils are taxadjuncts to the Malvern series because the surface layer is not thick enough to qualify as a mollic epipedon.

Typical pedon of Malvern silty clay loam, 9 to 14 percent slopes, moderately eroded, in a pasture; 800 feet east and 140 feet south of the northwest corner of sec. 23, T. 72 N., R. 39 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of dark yellowish brown (10YR 4/4) silty clay loam subsoil material; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

BA—7 to 12 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine faint dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; common fine roots; few fine dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

2Bt1—12 to 18 inches; dark brown (7.5YR 4/4) silty clay; few fine distinct reddish brown (5YR 4/4) and grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; few fine dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

2Bt2—18 to 24 inches; reddish brown (5YR 4/3) silty clay; common fine faint yellowish red (5YR 4/6) and few fine prominent grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; very firm; few fine roots; few faint clay films on faces of peds; few fine dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

2Bt3—24 to 33 inches; brown (7.5YR 4/4) and yellowish red (5YR 4/6) silty clay; moderate medium prismatic structure parting to moderate fine subangular blocky; very firm; few distinct clay films on faces of peds; few fine dark concretions (iron and manganese oxides); neutral; clear smooth boundary.

2Bt4—33 to 46 inches; mottled brown (7.5YR 4/4) and yellowish red (5YR 4/6) silty clay; moderate medium prismatic structure; very firm; few distinct clay films on faces of peds; few fine dark concretions (iron and manganese oxides); neutral; clear smooth boundary.

2BC—46 to 60 inches; brown (7.5YR 4/4) silty clay; few fine prominent gray (10YR 6/1) and few fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; very firm; few fine dark concretions (iron and manganese oxides); neutral.

The solum ranges from 36 to 60 inches or more in thickness. The depth to carbonate accumulation is 45 inches or more. The dark Ap horizon ranges from 7 to 10 inches in thickness.

The A horizon has value and chroma of 2 or 3. The 2Bt horizon has hue of 7.5YR, 5YR, or 10YR, value of 4 to 6, and chroma of 3 to 6. The 2BC horizon has value of 4 to 6 and chroma of 4 to 8.

Marshall Series

The Marshall series consists of well drained, moderately permeable soils on upland and high stream benches. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 0 to 14 percent.

Typical pedon of Marshall silty clay loam, 9 to 14 percent slopes, in a cultivated field; 200 feet south and 80 feet east of the northwest corner of sec. 4, T. 73 N., R. 39 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10Y 4/2) dry; weak fine granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.

AB—9 to 17 inches; very dark grayish brown (10YR 3/2) silty clay loam; some mixing of dark brown (10YR 3/3) and brown (10YR 4/3) silty clay loam subsoil material; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; slightly acid; clear smooth boundary.

Bw1—17 to 22 inches; dark brown (10YR 3/3) and brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; few fine roots; medium acid; gradual smooth boundary.

Bw2—22 to 30 inches; brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; few fine roots; few faint clay films on faces of some peds; medium acid; gradual smooth boundary.

Bw3—30 to 36 inches; brown (10YR 4/3) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; friable; few fine roots; few faint clay films on faces of few peds; medium acid; gradual smooth boundary.

Bw4—36 to 44 inches; brown (10YR 4/3) silty clay loam; common fine faint grayish brown (10YR 5/2) and few fine distinct dark brown (7.5YR 4/4) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

BC—44 to 53 inches; mottled yellowish brown (10YR 5/6), grayish brown (10YR 5/2), and dark brown (7.5YR 4/4) silty clay loam; weak fine and medium prismatic structure parting to weak medium subangular blocky; friable; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

C—53 to 60 inches; mottled yellowish brown (10YR 5/6), grayish brown (10YR 5/2), and dark brown (7.5YR 4/4) silt loam; massive; friable; few dark concretions (iron and manganese oxides); slightly acid.

The solum ranges from 40 to 60 inches or more in thickness. The mollic epipedon ranges from 10 to 17 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silt loam. The Bw horizon has value of 3 to 5 and chroma of 2 to 4. The C horizon has value of 4 or 5 and chroma of 2 to 6. It is silt loam, but the range includes silty clay loam.

Mayberry Series

The Mayberry series consists of moderately well drained, slowly permeable soils on the convex tops of low ridges and on the sides of high terraces that border stream valleys. These soils formed in material reworked from weathered glacial till. Native vegetation was tall prairie grasses. Slopes range from 5 to 14 percent.

These soils are taxadjuncts to the Mayberry series because the surface layer is not thick enough to qualify as a mollic epipedon.

Typical pedon of Mayberry silty clay loam, 5 to 14 percent slopes, moderately eroded, in a cultivated field; 420 feet east and 1,180 feet south of the northwest corner of sec. 11, T. 73 N., R. 36 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; mixed with some streaks and pockets of dark brown (7.5YR 3/2) subsoil material; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

Bt1—8 to 17 inches; dark brown (7.5YR 3/2) clay; few fine faint dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; firm; few fine roots; few distinct clay films on faces of peds; few dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt2—17 to 27 inches; dark brown (7.5YR 4/4) clay; common fine distinct reddish brown (5YR 4/4) and few fine faint grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; few fine roots; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt3—27 to 37 inches; dark reddish brown (5YR 3/4) clay; few fine prominent dark grayish brown (10YR 4/2) and few fine faint strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to strong medium subangular blocky; very firm; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt4—37 to 45 inches; dark reddish brown (5YR 3/4) clay; few fine prominent grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to strong medium subangular blocky; very firm; few faint clay films on faces of peds; few dark

concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Bt5—45 to 52 inches; dark brown (7.5YR 4/4) clay; few fine distinct grayish brown (10YR 5/2), few fine faint strong brown (7.5YR 5/6), and few fine distinct dark reddish brown (5YR 3/4) mottles; moderate medium prismatic structure parting to strong medium subangular blocky; very firm; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

BC—52 to 60 inches; yellowish brown (10YR 5/4) clay loam; few fine faint grayish brown (10YR 5/2) and common fine distinct dark brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to strong medium subangular blocky; firm; few faint clay films on faces of peds; few fine concretions (iron and manganese oxides); slightly acid.

The solum ranges from 40 to 60 inches or more in thickness. The dark Ap horizon ranges from 8 to 10 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes loam and clay loam. The Bt horizon has value of 3 to 5 and chroma of 2 to 5. It is dominantly clay, but the range includes sandy clay. Some pedons have a C horizon within depths of 50 inches.

Minden Series

The Minden series consists of somewhat poorly drained, moderately permeable soils on nearly level high benches. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Minden silty clay loam, benches, 0 to 2 percent slopes, in a cultivated field; 75 feet west and 1,360 feet north of the southeast corner of sec. 29, T. 72 N., R. 36 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; few fine roots and pores; neutral; clear smooth boundary.

A1—8 to 15 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to moderate fine and medium granular; friable; few fine roots and pores; slightly acid; clear smooth boundary.

A2—15 to 21 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure parting to moderate fine and medium granular; friable; few fine roots and pores; medium acid; gradual smooth boundary.

Bw1—21 to 26 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine distinct brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots and pores; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bw2—26 to 32 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; few fine roots and pores; few very dark gray (10YR 3/1) fills in old root channels; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bw3—32 to 40 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine faint olive brown (2.5Y 4/4) and grayish brown (2.5Y 5/2) mottles; weak fine subangular blocky structure; friable; few fine roots and pores; few very dark gray (10YR 3/1) fills in old root channels; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

BC—40 to 49 inches; grayish brown (2.5Y 5/2) silty clay loam; few dark grayish brown (2.5Y 4/2) coatings on faces of peds; weak fine prismatic structure parting to weak fine subangular blocky; friable; few fine roots and pores; few very dark gray (10YR 3/1) fills in old root channels; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

C—49 to 60 inches; mottled grayish brown (2.5Y 5/2), dark brown (7.5YR 4/4), and strong brown (7.5YR 5/6) silty clay loam; massive; friable; common dark concretions (iron and manganese oxides); medium acid.

The solum ranges from 40 to 60 inches or more in thickness. The mollic epipedon ranges from 16 to 24 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silt loam. The Bw horizon has value of 4 or 5. The C horizon has value of 4 or 5 and chroma of 2 to 6.

Nevin Series

The Nevin series consists of somewhat poorly

drained, moderately permeable soils on low alluvial terraces or second bottoms. These soils formed in alluvium. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Nevin silty clay loam, 0 to 2 percent slopes, in a cultivated field; 400 feet east and 2,560 feet north of the southwest corner of sec. 12, T. 72 N., R. 39 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; few fine roots; neutral; clear smooth boundary.

A1—9 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; neutral; gradual smooth boundary.

A2—17 to 24 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

BA—24 to 31 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark gray (10YR 3/1) coatings on faces of peds; weak fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

Bt1—31 to 39 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; neutral; clear smooth boundary.

Bt2—39 to 46 inches; dark grayish brown (10YR 4/2) and brown (10YR 5/3) silty clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; few fine roots; few faint clay films on faces of peds; few soft accumulations (iron and manganese oxides); neutral; clear smooth boundary.

BC—46 to 53 inches; grayish brown (10YR 5/2) silty clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; few dark concretions (iron and manganese oxides); neutral; clear smooth boundary.

C—53 to 60 inches; grayish brown (10YR 5/2) silty clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; massive; friable; few dark concretions (iron and manganese oxides); neutral.

The solum ranges from 36 to 60 inches in thickness. The mollic epipedon ranges from 18 to 30 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silt loam. The B horizon has value of 4 or 5 and chroma of 2 or 3. The C horizon has value of 4 or 5 and chroma of 2 or 3. It is dominantly silty clay loam, but the range includes silt loam.

Nodaway Series

The Nodaway series consists of moderately well drained, moderately permeable soils on flood plains. These soils formed in alluvium. Native vegetation was mixed tall prairie grasses and deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Nodaway silt loam, 0 to 2 percent slopes, in a cultivated field; 60 feet east and 340 feet south of the northwest corner of sec. 31, T. 73 N., R. 39 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

C—8 to 60 inches; stratified very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), and grayish brown (10YR 5/2) silt loam; massive but tending to be platy because of stratification; common fine faint yellowish brown (10YR 5/6) stratification; friable; common fine roots in upper part and few fine roots in lower part of horizon; slightly acid.

The solum and the surface layer are both 6 to 10 inches in thickness.

The A or Ap horizon has chroma of 1 or 2. The C horizon has value of 3 to 5 and chroma of 1 to 4. It is dominantly silt loam but has thin strata of silty clay loam, fine sandy loam, and loam. Some pedons have a black silty clay loam buried soil within depths of 45 inches.

Northboro Series

The Northboro series consists of moderately well drained, moderately slowly permeable soils on convex secondary ridgetops and convex side slopes in uplands. These soils formed in loess and erosional sediments over a paleosol weathered from glacial till. Native vegetation was tall prairie grasses. Slopes range from 5 to 14 percent.

These soils are taxadjuncts to the Northboro series

because the surface layer is not thick enough for a mollic epipedon and the soils have an argillic horizon.

Typical pedon of Northboro silty clay loam, 5 to 14 percent slopes, moderately eroded, in a cultivated field; 100 feet west and 1,760 feet south of the northeast corner of sec. 31, T. 73 N., R. 39 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam (about 28 percent clay), dark grayish brown (10YR 4/2) dry; mixed with streaks and pockets of dark brown (7.5YR 4/4) subsoil material; weak fine granular structure; friable; few fine roots; medium acid; abrupt smooth boundary.

Bt1—8 to 18 inches; dark brown (7.5YR 4/4) silty clay loam (about 33 percent clay); weak fine subangular blocky structure; friable; few fine roots; few faint clay films on some ped faces; medium acid; clear smooth boundary.

Bt2—18 to 27 inches; strong brown (7.5YR 5/6) silty clay loam (about 35 percent clay); weak fine and medium subangular blocky structure; friable; few fine roots; few faint clay films on some ped faces; few dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

Bt3—27 to 37 inches; strong brown (7.5YR 5/6) silty clay loam (about 38 percent clay); moderate medium prismatic structure parting to weak fine and medium subangular blocky; firm; few fine roots; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); slightly acid; abrupt smooth boundary.

2Bt4—37 to 47 inches; yellowish brown (10YR 5/6) clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few fine roots; few faint clay films on faces of some peds; few dark concretions (iron and manganese oxides); common fine pebbles; slightly acid; clear smooth boundary.

2Bt5—47 to 55 inches; yellowish brown (10YR 5/6) clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few faint clay films on some ped faces; few dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

2BC—55 to 60 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; few dark concretions (iron and manganese oxides); common fine pebbles; slightly acid.

The solum ranges from 36 to 60 inches or more in thickness. The dark Ap horizon ranges from 8 to 10 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3. It is dominantly silty clay loam, but the range includes silt loam. The Bt horizon has hue of 5YR or 7.5YR. It is dominantly silty clay loam, but the range includes silt loam. The 2Bt horizon has hue of 7.5YR or 10YR, and value and chroma of 4 to 6. It is dominantly clay loam, but the range includes loam and strata of other textures. In some pedons the pebble band or stone line is below depths of 60 inches.

Olmitz Series

The Olmitz series consists of moderately well drained, moderately permeable soils on foot slopes or alluvial fans. These soils formed in local alluvium. Native vegetation was tall prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Olmitz loam, 2 to 5 percent slopes, in a pasture; 200 feet west and 2,000 feet north of the southeast corner of sec. 5, T. 71 N., R. 37 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

A1—9 to 17 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; common fine roots; slightly acid; gradual smooth boundary.

A2—17 to 23 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; few fine roots; slightly acid; gradual smooth boundary.

A3—23 to 31 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

Bw1—31 to 39 inches; brown (10YR 4/3) clay loam; dark brown (10YR 3/3) coatings on faces of peds; weak medium prismatic structure parting to weak fine subangular blocky; friable; medium acid; gradual smooth boundary.

Bw2—39 to 46 inches; dark yellowish brown (10YR 4/4) clay loam; dark brown (10YR 3/3) coatings on faces of peds; weak medium prismatic structure parting to weak fine subangular blocky; friable; medium acid; gradual smooth boundary.

Bw3—46 to 53 inches; brown (10YR 4/3) clay loam;

weak medium prismatic structure parting to weak fine subangular blocky; firm; slightly acid; gradual smooth boundary.

BC—53 to 60 inches; dark yellowish brown (10YR 4/4) clay loam; brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; firm; slightly acid.

The solum ranges from 36 to 60 inches or more in thickness. The mollic epipedon ranges from 24 to 32 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly loam, but the range includes clay loam. The Bw horizon has chroma of 3 or 4.

Sharpsburg Series

The Sharpsburg series consists of deep, moderately well drained, moderately slowly permeable soils on uplands and high stream benches. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes ranges from 0 to 14 percent.

Typical pedon of Sharpsburg silty clay loam, 2 to 5 percent slopes, in a cultivated field; 200 feet east and 140 feet north of the southwest corner of sec. 36, T. 71 N., R. 36 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common fine roots; strongly acid; abrupt smooth boundary.

AB—9 to 17 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; few fine roots; strongly acid; clear smooth boundary.

Bt1—17 to 27 inches; brown (10YR 4/3) silty clay loam; weak fine prismatic structure parting to weak fine subangular blocky; friable; few fine roots; few faint clay films on faces of peds; medium acid; clear smooth boundary.

Bt2—27 to 36 inches; brown (10YR 4/3) silty clay loam; few fine distinct strong brown (7.5YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to weak fine and medium subangular blocky; friable; few fine roots; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt3—36 to 46 inches; brown (10YR 4/3) silty clay loam; few fine distinct strong brown (7.5YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; few fine roots; few faint clay films on faces of peds; few dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

BC—46 to 52 inches; mottled brown (10YR 4/3), grayish brown (10YR 5/2), and dark brown (7.5YR 4/4) silty clay loam; weak fine prismatic structure parting to weak fine subangular blocky; friable; few fine roots; few dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

C—52 to 60 inches; mottled grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) silty clay loam; massive; friable; few fine roots; few brown (10YR 4/3) clay flows in root channels; few dark concretions (iron and manganese oxides); slightly acid.

The solum ranges from 36 to 60 inches or more in thickness. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 to 3. It is dominantly silty clay loam, but the range includes silt loam. The B horizon has value of 4 or 5 and chroma of 3 or 4. It is dominantly silty clay loam, but the range includes silty clay with a clay maximum between 36 and 42 percent. The C horizon has value of 4 to 6 and chroma of 2 to 6.

Shelby Series

The Shelby series consists of moderately well drained, moderately slowly permeable soils on uplands. These soils formed in glacial till. Native vegetation was tall prairie grasses. Slopes range from 9 to 25 percent.

Typical pedon of Shelby loam, 9 to 14 percent slopes, in a pasture; 2,080 feet east and 100 feet south of the northwest corner of sec. 30, T. 73 N., R. 36 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; some mixing of dark brown (10YR 3/3) subsoil material; weak fine granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

AB—7 to 12 inches; dark brown (10YR 3/3) clay loam; few brown (10YR 4/3) mixings; very dark gray (10YR 3/1) coatings on faces of some peds; weak fine subangular blocky structure; friable; few fine roots; slightly acid; clear smooth boundary.

Bt1—12 to 23 inches; brown (10YR 4/3) clay loam; moderate fine and medium subangular blocky

structure; firm; few fine roots; common faint clay films on faces of peds; few dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt2—23 to 34 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct brown (7.5YR 5/4) and strong brown (7.5YR 5/6) and few fine faint grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure parting to weak fine and medium subangular blocky; firm; few fine roots; common distinct clay films on faces of peds; common dark concretions (iron and manganese oxides); few fine pebbles; medium acid; clear smooth boundary.

Bt3—34 to 45 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct strong brown (7.5YR 5/6) and grayish brown (2.5Y 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; few dark concretions (iron and manganese oxides); few fine pebbles; medium acid; clear smooth boundary.

BC—45 to 53 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; few fine dark concretions (iron and manganese oxides); few fine pebbles, medium acid; clear smooth boundary.

C—53 to 60 inches; grayish brown (2.5Y 5/2) clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; massive; common dark concretions (iron and manganese oxides); few fine pebbles; neutral.

The solum ranges from 40 to 60 inches in thickness. The depth to free carbonates ranges from 36 to 60 inches or more. The mollic epipedon ranges from 10 to 16 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly loam, but the range includes clay loam and silt loam. The B horizon has value of 4 or 5 and chroma of 3 or 4. The C horizon has value of 4 or 5 and chroma of 2 to 6.

Steinauer Series

The Steinauer series consists of well drained, moderately slowly permeable soils on steep convex side slopes. These soils formed in calcareous glacial till. Native vegetation was tall prairie grasses. Slopes range from 9 to 18 percent.

Typical pedon of Steinauer clay loam, 14 to 18 percent slopes, moderately eroded, in a pasture; 450 feet west and 1,600 feet south of the northeast corner of sec. 33, T. 71 N., R. 37 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; mixed with some streaks and pockets of dark yellowish brown (10YR 4/4) subsoil material; weak fine granular structure; friable; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

AC—6 to 20 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) clay loam; weak fine subangular blocky structure; friable; few fine roots; very dark gray (10YR 3/1) organic flows in some root channels; few fine dark concretions (oxides); common soft accumulations (calcium carbonates); strong effervescence; moderately alkaline; clear smooth boundary.

C1—20 to 33 inches; yellowish brown (10YR 5/4) clay loam; few fine faint strong brown (7.5YR 5/6) mottles; massive; firm; few fine pebbles; concentrated zone of soft accumulations (calcium carbonates) 2 inches thick at a depth of 23 inches; strong effervescence; moderately alkaline; diffuse smooth boundary.

C2—33 to 60 inches; grayish brown (2.5Y 5/2) clay loam; common fine faint gray (10YR 5/1) and common fine distinct olive brown (2.5Y 4/4) mottles; massive; firm; few small pebbles; strong effervescence; moderately alkaline.

The solum ranges from 6 to 21 inches in thickness. The depth to free carbonates ranges from 0 to 10 inches.

The A horizon has value of 3 to 5 and chroma of 1 or 2. It is dominantly clay loam, but the range includes loam. The AC horizon has value of 4 or 5 and chroma of 1 to 6. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is dominantly clay loam, but the range includes loam.

Zook Series

The Zook series consists of poorly drained, slowly permeable soils on flood plains. These soils formed in alluvium. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Zook silty clay loam, 0 to 2 percent slopes, in a cultivated field; 200 feet west and 800 feet south of the northeast corner of sec. 14, T. 72 N., R. 39 W.

Ap—0 to 7 inches; black (N 2/0) silty clay loam, black (N 2/0) dry; weak fine granular structure; friable; few fine roots; slightly acid; clear smooth boundary.

A1—7 to 16 inches; black (N 2/0) silty clay loam, black (N 2/0) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; slightly acid; clear smooth boundary.

A2—16 to 30 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; moderate fine and medium subangular blocky structure; firm; few fine roots; slightly acid, gradual smooth boundary.

Bg—30 to 42 inches; very dark gray (10YR 3/1) silty clay; dark gray (5Y 4/1) coatings on faces of some peds; few fine faint grayish brown (2.5Y 5/2) mottles; moderate medium subangular blocky structure; firm; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

BCg—42 to 52 inches; dark gray (5Y 4/1) silty clay; few fine faint grayish brown (2.5Y 5/2) and gray (5Y 5/1) mottles; moderate medium subangular blocky structure; firm; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Cg—52 to 60 inches; dark gray (5Y 4/1) silty clay; few fine faint grayish brown (2.5Y 5/2) and gray (5Y 5/1) mottles; massive; firm; very dark gray (10YR 3/1) organic flows in root channels; few dark concretions (iron and manganese oxides); neutral.

The solum ranges from 36 to 60 inches in thickness. The mollic epipedon ranges from 36 to 50 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 0 or 1, but the range includes value of 4 and chroma of 2 in overwash phases. It is dominantly silty clay loam, but the range includes silty clay and silt loam. The Bg horizon has value of 2 to 4 and chroma of 1 or less. It is dominantly silty clay, but the range includes silty clay loam. The C horizon has value of 3 to 5 and chroma of 1.

Formation of the Soils

In this section, the factors that have affected the formation of soils in Montgomery County are described and the processes of soil formation are explained.

Factors of Soil Formation

Soils form through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate during and after the accumulation of the soil material, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time that the forces of soil formation have acted on the soil material. Human activities also affect soil formation.

Climate and plant and animal life, chiefly plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks. They slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Generally, a long period is needed for the formation of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Parent Material

The soils of Montgomery County formed in loess, alluvium, and glacial till. Cretaceous limestone and shale are exposed at the base of slopes and steep side slopes in several places in the county. Dakota Sandstone is exposed in the county on side slopes along the southern two-thirds of the East Nishnabotna River and along some of its major tributaries. The most notable outcropping is in a roadcut south of Coburg. The outcropping of these parent materials is of minor extent and its effects on the soil in the area are limited.

Loess, the most extensive parent material, is the parent material of eight different soils in the county, which make up about half the total acreage. Loess is yellowish brown, wind-deposited material that consists largely of silt particles and smaller amounts of clay and sand. Most of the upland soils formed in Wisconsinan loess. The most extensive of these are Marshall, Exira, and Sharpsburg soils.

The wind probably carried most of the Wisconsinan loess from the flood plain along the Missouri River to the uplands during the Wisconsinan Glaciation, about 25,000 to 14,000 years ago *(10)*. The thickness of the loess and the differences among the soils that formed in it are related to the distance from the Missouri River *(6, 10)*. The loess is about 18 feet thick in the western part of the county. In the eastern part, it thins to about 12 feet. In some areas, mainly on hillsides adjacent to stream valleys, it has been removed by geologic erosion. In these areas glacial till or Loveland Loess is exposed.

The loess in the eastern and southern parts of Iowa thins out and becomes finer textured than that in the southwestern part *(6, 10)*. A change in texture is evident in Montgomery County. Marshall soils are in the western part of the county, and are lower in content of clay than Sharpsburg soils, which are in the eastern part.

The older Loveland Loess is exposed in places on side slopes. It was deposited during the Illinoian glacial episode *(10, 11)*. A reddish paleosol formed in this loess during the Sangamon Interglacial Period. It was subsequently covered by Wisconsinan loess. Malvern soils formed in areas where the paleosol was exposed by geologic erosion. The loess in the western part of Iowa has been analyzed in a number of studies *(3, 4, 5, 6, 12, 13, 17)*.

Alluvium is the second most extensive parent

material in the county. It makes up about 35 percent of the total acreage. It is sediment deposited by water along the major streams and along narrow upland drainageways. The alluvium ranges from silt to clay because of differences among the material from which it came and the manner in which it was deposited. More than half the soils that formed in alluvium are in large areas along the East Nishnabotna River and West and Middle Nodaway Rivers, in areas along Walnut, Indian, and Tarkio Creeks, and in small areas along upland streams and drainageways.

Some alluvial material, called local alluvium, has been transported only a short distance. Such alluvium retains many characteristics of the soils in the areas from which it eroded. Judson and Olmitz soils, for example, generally are at the base of slopes and are lower on the landscape than the soils formed in loess and till. All the soils at the base of slopes are similar in texture to the soils upslope.

The alluvial soils are in two broad groups. One group formed in alluvium that has been in place long enough for soil-forming factors to have effected the soils. Examples of this group are Zook, Colo, and Kennebec soils. Another group formed in recent alluvium. Examples of this other group are Nodaway and Ackmore soils. The accumulation of organic matter in the first group has made these soils darker in the upper part and dark to a greater depth than the soils in the second group.

The texture of the soils formed in alluvium varies. Zook soils formed in clayey alluvium. Nodaway and Kennebec soils are dominantly silt loam throughout, and Colo soils are dominantly silty clay loam throughout. Some soils derived from alluvium, such as Ackmore soils, have layers of different texture. Nevin and Bremer soils are dominantly silty clay loam throughout. They are on low stream benches or second bottoms along the major streams in the county. They are not subject to flooding. They have a profile that is more strongly expressed than that of soils derived from alluvium on first bottoms, which are subject to flooding.

Glacial till is the parent material of about 15 percent of the soils in the county. Thick glacial till deposits are throughout the uplands. In the western three-fourths of the county, glacial till is mostly covered by loess except on upland hillsides near the major drainageways where the loess has been removed by erosion. In the eastern fourth of the county, till is exposed on the lower parts of most side slopes.

Most of the glacial till was probably deposited during the Kansan Glaciation. A few exposures may be from the earlier Nebraskan Glaciation. The unweathered till is a heterogeneous mixture. It is firm, calcareous clay loam that contains pebbles, boulders, and sand as well as silt and clay. It shows little evidence of sorting or stratification. The mineral composition also is heterogeneous, and is similar to that of particles in unweathered loess.

Some soils formed on the Kansan till plain during the Yarmouth and Sangamon Interglacial periods before the loess was deposited. They are called Yarmouth-Sangamon paleosol. The nearly level soils on this plain are strongly weathered and have a gray, plastic subsoil called gumbotil *(11)*. Clarinda and Lamoni soils are examples of the soils formed in this paleosol. The gumbotil is several feet thick and very slowly permeable.

A widespread erosion surface has cut below the Yarmouth-Sangamon paleosol into Kansan till and older deposits. It generally is characterized by a stone line or subjacent sediment and is surmounted by pedisediment. A paleosol formed in the pedisediment, stone line, and generally subjacent till. This surface is of late Sangamon age. The paleosol is less strongly weathered, more reddish, and not so thick as those in the nearly level areas. Adair soils are an example of soils formed in this paleosol.

The soils formed in the Kansan till during the Yarmouth and Sangamon periods were covered by loess. Geologic erosion has removed the loess from some slopes and has exposed the paleosol. In other areas erosion has removed all the paleosol and has exposed till that is only slightly weathered at the surface. Shelby and Steinauer soils formed in this till.

Plant and Animal Life

Several kinds of living organisms affect soil formation. Burrowing animals, worms, crayfish, and micro-organisms, for example, influence soil properties. Differences in the kind of vegetation, however, commonly cause the most marked differences among soils.

When Montgomery County was settled tall grasses were the dominant vegetation. Trees grew in some areas, mainly in the steep areas within a few miles of the valleys of the East Nishnabotna River and the West and Middle Nodaway Rivers and in areas along the major streams. The thickest stands were on the north- and east-facing slopes.

Grasses have many roots and tops that decay; consequently, soils that formed on prairies typically have a thicker, darker surface layer than the soils formed under trees. The organic matter in the soils formed under trees is derived mainly from fallen leaves.

These soils generally are more acid than the soils formed under grasses. Ladoga and Gara soils are typical prairie-timber transition soils. Marshall and Exira soils are typical prairie soils. The stands of trees on these soils have not been in place long enough to significantly affect soil formation.

Climate

The soils in Montgomery County formed under a variety of climatic conditions. From about 13,000 to 10,500 years ago, the climate in central Iowa was cool and the vegetation was dominantly conifers *(16)*. Beginning about 10,500 years ago and ending about 8,000 years ago, a warming trend changed the vegetation from conifers to mixed hardwoods. Beginning about 8,000 years ago, the climate became warmer and drier and herbaceous prairie vegetation became dominant. Probably about 3,000 years ago, the climate began to change from dry to moister *(8)*. The soil in the county formed under the influence of this midcontinental, subhumid climate.

The climate is nearly uniform throughout the county; consequently, it has not resulted in major differences among the soils. The effect of the climate, however, is modified by local conditions in or near the soil. For example, most of the water received on steep hillslopes runs off or rapidly penetrates the surface. As a result, the microclimate on steep hillslopes is warmer and drier than is typical in the less sloping areas. It also is warmer and drier on south-facing slopes than on north- and east-facing slopes. As a result, natural stands of trees are more likely to grow well on the north- and east-facing slopes. The poorly drained or very poorly drained soils in low-lying areas or depressions are wetter and cooler than the soils in most of the surrounding areas.

Changes in the temperature activate the weathering of parent material by water and air. As the parent material weathers, changes caused by physical and chemical actions take place. Rainfall affects the amount of leaching in the soils and the kinds of plants on the soil. Temperature and other climatic factors indirectly affect soil formation through their effects on the plant and animal life on and in the soil.

Relief

Relief, or topography, refers to the lay of the land. In Montgomery County it ranges from nearly level to very steep. Relief is an important factor in soil formation because of its effect on drainage, runoff, height of the water table, and erosion. Some soils, such as the nearly level Minden soils and the sloping Marshall soils, differ mainly because they formed on different positions on the landscape.

The influence of relief is evident in soil color, the thickness of the solum, and the development of horizons. On the steeper slopes runoff is greater; consequently, the soil erodes so fast that little horizonation can take place. On the more level slopes where most of the water soaks in, runoff is less and erosion is less severe. The infiltrating water also leaches the more soluble minerals to a greater depth. Thus, soils formed in the steeper areas generally have a thinner surface layer and are calcareous nearer the surface, but soils formed in the more level areas generally have a thicker surface layer and have carbonates at a greater depth. Thus, for example, in Shelby, Exira, and other soils that range widely in slope, the depth to carbonates and the thickness of the solum decrease as the slope increases and as the surface becomes more convex.

Relief affects the color of the B horizon through its effect on drainage and soil aeration. In well drained soils, the subsoil generally is brown because oxidized iron compounds are well distributed throughout the horizon. For example, Judson soils at slightly higher elevations are well drained and have a brownish subsoil. In contrast, soils where drainage is restricted have a grayish, mottled subsoil. As an example, the low-lying, poorly drained Zook soils on bottom lands have a grayish subsoil.

Time

Over time, relief, climate, and plant and animal life change the parent material. If these factors continue to operate for a long period of time, similar kinds of soil form in widely different kinds of parent material. Soil formation, however, generally is interrupted by geologic events that expose new parent material.

In Montgomery County, the bedrock was covered by glacial drift of both the Nebraskan and Kansan Glaciations. Later, the Loveland Loess was deposited and then the Wisconsinan loess.

The subsoil in Clarinda and Adair soils is the most weathered in the county *(11)*. Clarinda soils formed in Kansan till, which began to weather during the Yarmouth and Sangamon Interglacial Periods, and which then was covered by loess. More recently, the upper part of this ancient subsoil was exposed to weathering again when the loess was removed by erosion. Adair soils formed similarly to Clarinda soils, but they weathered for a shorter period before they were covered by loess.

About 90 percent of the soils in Montgomery County are less than 14,000 years old. Radiocarbon dating indicates that loess deposition began about 25,000 years ago and continued to about 14,000 years ago. Based on these dates, the surface of the nearly level, loess-mantled divides in Iowa is about 14,000 years old. In much of Iowa, including Montgomery County, geologic erosion has beveled and in places removed material on side slopes and deposited new sediments downslope *(11)*. The soil material on the surface of the nearly level upland divides is older than that on the slopes that truncate the divides. Thus, the soils on these side slopes are less than 14,000 years old.

The sediments eroded from the side slopes have accumulated downslope as local alluvium. The age of soil material on the side slopes can be determined by dating the alluvial fill at the base of the slopes. Studies indicate that the alluvium in some stream valleys in western Iowa is less than 1,800 years old *(3)*. In Adair County, in the southwest part of Iowa, studies indicate that the base of the alluvial fill is about 6,800 years old *(11)*. The soil material on the surface of side slopes is as young as or younger than these parent materials. Judson, Olmitz, Kennebec, and other soils formed in similar alluvium.

Human Activities

Important changes take place in the soil after it is drained and cultivated. Changes caused by water erosion generally are the most significant. On many of the cultivated soils in the county, much of the surface layer has been lost through erosion, and in some places gullies have formed. Tilling the surface layer alters the structure of the soil. Less obvious are other changes. Applications of lime and fertilizer brought about chemical changes. Removing the native vegetation and growing crops resulted in changes in microbial activity and organic matter content.

Human activities have strongly affected the formation of Ackmore soils and the overwash phases of Colo, Zook, and Kennebec soils. New parent material, which is light colored, has covered these originally dark soils. This material eroded from the uplands, generally because of farming.

Processes of Soil Formation

Horizon differentiation is caused by at least four processes: additions, removals, transfers, and transformations. Each of these processes affects many substances that make up a soil. Examples are the addition, removal, transfer, or transformation of organic matter, soluble salts, carbonates, sesquioxides, or silicate clay minerals.

Generally, these processes promote horizon differentiation, but some tend to retard it. These processes and the changes they bring about proceed simultaneously in soils. The ultimate nature of the profile is governed by the balance of those changes within the profile.

In Montgomery County the soils on flood plains are divided into two broad groups. The groups are based mainly on the additions of organic matter. The soils that have a thick, dark surface layer are separated from those that do not. The dark color, or lack of it, is the most obvious difference between Colo soils and Nodaway soils. In some soils on uplands, Steinauer soils, for example, the dark surface layer is the only soil feature that reflects the processes of soil formation.

The removal of substances from parts of the soil profile accounts for some of the most obvious differences among soils in the county. An example is the downward movement of calcium carbonates that results from leaching. Leaching has removed calcium carbonates from the upper part of Marshall and Shelby soils. This removal, along with other processes, has resulted in the differentiation of a B horizon. In contrast, calcium carbonates have been removed in Steinauer soils. These soils are calcareous at or near the surface, and do not have a B horizon.

The transfer of substances from one horizon to another is evident in the soils of Montgomery County. Phosphorus is removed from the subsoil by plant roots and is transferred to parts of the plant growing above the ground. Then, in the plant residue, it is added to the surface layer.

The translocation of silicate clay minerals helps to differentiate horizons. In translocation, clay minerals from the A horizon are carried downward in suspension in percolating water. They accumulate in the B horizon in pores and root channels and as clay films on the faces of peds. Adair, Bremer, Clarinda, Corley, Malvern, Nevin, Sharpsburg, and Shelby soils, for example, have been markedly affected by this process. In other soils, the content of clay in the A horizon is not markedly different from that in the B horizon and other evidence of clay movement is minimal.

Transformations are physical and chemical processes. Soil particles, for example, weather to smaller sizes. The reduction of iron, in a process called gleying, is common in poorly drained soils, such as Colo and Zook soils. These soils are gleyed and have grayish colors, because they are saturated for long periods. Another kind of transformation is the

weathering of a primary apatite mineral, present in parent material, to a secondary phosphorus compound. Apparently, the pH level must decline to about 7 before much of this weathering can take place. This transformation is the reason for the differences in the supply of available phosphorus among soils formed in similar calcareous parent material. Steinauer soils, for example, are calcareous but have a very low supply of available phosphorus. In contrast, Shelby soils, which have been leached to about neutral, have a bigger supply of available phosphorus.

References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vols., illus.

(2) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.

(3) Daniels, Raymond B., and Robert H. Jordan. 1966. Physiographic history and the soils, entrenched stream systems, and gullies, Harrison County, Iowa. U.S. Dep. Agric. Tech. Bull. 1348, 116 pp., illus.

(4) Davidson, D.T., and others. (n.d.) Geologic and engineering properties of Pleistocene materials in Iowa. Iowa Eng. Exp. Stn. Bull. 191, Iowa Highw. Res. Board Bull. 20, Joint Publ. 250, illus.

(5) Godfrey, C.L., and Frank F. Riecken. 1957. Solubility of phosphorus in some genetically related loess-derived soils. Soil Sci. Soc. Am. Proc. 21: 232-235.

(6) Hutton, Curtis E. 1947. Studies of loess-derived soils in southwestern Iowa. Soil Sci. Soc. Am. Proc. 12: 424-431, illus.

(7) Iowa Crop and Livestock Reporting Service. 1986. Iowa agricultural statistics. 133 pp., illus.

(8) McComb, A.L., W.E. Loomis, and F.F. Riecken. 1961. Effect of vegetation on soils in the forest-prairie region. Rec. Adv. Bot., Univ. Toronto Press. pp. 1627-1631.

(9) O'Neal, A.M., Jr., and L.L. Rhodes. 1919. Soil Survey of Montgomery County, Iowa. U.S. Dep. Agric., Bur. of Soils. 30 pp., illus.

(10) Ruhe, Robert V. 1969. Quaternary landscapes in Iowa. Iowa State Univ. Press, 255 pp., illus.

(11) Ruhe, Robert V., R.B. Daniels, and J.G. Cady. 1967. Landscape evolution and soil formation in southwestern Iowa. U.S. Dep. Agric. Tech. Bull. 1349, 242 pp., illus.

(12) Ulrich, Rudolph. 1950. Some physical changes accompanying prairie, wisenboden, and planosol soil profile development from Peorian loess in southwestern Iowa. Soil Sci. Soc. Am. Proc. 14: 287-295, illus.

(13) Ulrich, Rudolph. 1951. Some chemical changes accompanying profile formation of the nearly level soils developed from Peorian loess in southwestern Iowa. Soil Sci. Soc. Am. Proc. 14: 324-329, illus.

(14) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(15) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(16) Walker, Patrick H. 1966. Postglacial erosion and environment changes in central Iowa. Soil and Water Conserv. 21: 21-23.

(17) White, E.M., J.E. McClelland, C.L. Coultas, and R.C. Prill. 1959. Soil survey of Monona County, Iowa. U.S. Dep. Agric., Soil Conserv. Serv., 41 pp., illus.

Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bottom land. The normal flood plain of a stream, subject to flooding.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants

throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gumbotil. A leached, deoxidized clay containing siliceous stones. The product of thorough chemical weathering of clay-rich glacial till.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Low strength. The soil is not strong enough to support loads.

Meadow crops. Perennial, herbaceous vegetation, usually grass or grass-like, used primarily for hay production, but also as green manure.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common*, and *many*; size—*fine, medium*, and *coarse*; and contrast—*faint, distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are—

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils

of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-84 at Red Oak, Iowa)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	30.5	10.6	20.6	57	3	0	0.86	0.25	1.34	3	7.9
February----	37.6	16.8	27.2	65	3	7	1.09	.34	1.69	3	7.1
March-------	48.1	26.5	37.3	81	3	33	2.28	.81	3.50	5	5.8
April-------	64.3	39.3	51.8	90	17	136	3.48	1.85	4.91	7	1.2
May---------	75.5	50.3	62.9	93	29	405	4.20	2.22	5.92	8	.1
June--------	84.8	59.8	72.3	99	41	669	5.06	2.45	7.32	7	.0
July--------	89.2	64.5	76.9	102	47	834	3.97	1.53	6.01	6	.0
August------	87.0	62.2	74.6	101	44	763	4.54	1.92	6.75	7	.0
September---	78.4	52.7	65.6	96	30	468	3.81	1.76	5.55	6	.0
October-----	66.9	41.3	54.1	90	19	189	2.37	.70	3.73	5	.2
November----	49.5	28.6	39.1	74	3	10	1.61	.42	2.56	3	2.7
December----	36.6	17.6	27.1	64	3	0	1.12	.44	1.69	3	6.1
Yearly:											
Average----	62.4	39.2	50.8	---	---	---	---	---	---	---	---
Extreme----	---	---	---	103	3	---	---	---	---	---	---
Total------	---	---	---	---	---	3,514	34.39	27.80	39.88	63	31.1

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by two, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-84 at Red Oak, Iowa)

Probability	Temperature		
	24^{o} F or lower	28^{o} F or lower	32^{o} F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 22	May 3	May 14
2 years in 10 later than--	Apr. 17	Apr. 28	May 9
5 years in 10 later than--	Apr. 8	Apr. 19	Apr. 30
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 10	Sept. 30	Sept. 19
2 years in 10 earlier than--	Oct. 17	Oct. 6	Sept. 24
5 years in 10 earlier than--	Oct. 29	Oct. 16	Oct. 3

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-84 at Red Oak, Iowa)

Probability	Daily minimum temperature during growing season		
	Higher than 24^{o} F	Higher than 28^{o} F	Higher than 32^{o} F
	Days	Days	Days
9 years in 10	183	157	135
8 years in 10	190	165	141
5 years in 10	204	179	155
2 years in 10	217	192	168
1 year in 10	225	200	175

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
8B	Judson silty clay loam, 2 to 5 percent slopes	11,085	4.1
8C	Judson silty clay loam, 5 to 9 percent slopes	760	0.3
9	Marshall silty clay loam, 0 to 2 percent slopes	1,030	0.4
9B	Marshall silty clay loam, 2 to 5 percent slopes	24,025	8.9
9C	Marshall silty clay loam, 5 to 9 percent slopes	1,090	0.4
9C2	Marshall silty clay loam, 5 to 9 percent slopes, moderately eroded	29,980	11.1
9D	Marshall silty clay loam, 9 to 14 percent slopes	555	0.2
9D2	Marshall silty clay loam, 9 to 14 percent slopes, moderately eroded	20,120	7.4
11B	Ackmore-Colo-Judson complex, 2 to 5 percent slopes	39,055	14.4
24D	Shelby loam, 9 to 14 percent slopes	695	0.3
24D2	Shelby loam, 9 to 14 percent slopes, moderately eroded	12,580	4.7
24E	Shelby loam, 14 to 18 percent slopes	510	0.2
24E2	Shelby loam, 14 to 18 percent slopes, moderately eroded	3,515	1.3
24F	Shelby loam, 18 to 25 percent slopes	505	0.2
33D2	Steinauer clay loam, 9 to 14 percent slopes, moderately eroded	660	0.2
33E2	Steinauer clay loam, 14 to 18 percent slopes, moderately eroded	670	0.2
43	Bremer silty clay loam, 0 to 2 percent slopes	1,420	0.5
54	Zook silty clay loam, 0 to 2 percent slopes	5,650	2.1
54+	Zook silt loam, overwash, 0 to 2 percent slopes	1,785	0.7
60D2	Malvern silty clay loam, 9 to 14 percent slopes, moderately eroded	220	0.1
76B	Ladoga silt loam, 2 to 5 percent slopes	200	0.1
76C	Ladoga silt loam, 5 to 9 percent slopes	240	0.1
76C2	Ladoga silt loam, 5 to 9 percent slopes, moderately eroded	1,230	0.5
76D	Ladoga silt loam, 9 to 14 percent slopes	695	0.3
76D2	Ladoga silt loam, 9 to 14 percent slopes, moderately eroded	2,335	0.9
88	Nevin silty clay loam, 0 to 2 percent slopes	675	0.2
93D2	Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded	5,325	2.0
99C2	Exira silty clay loam, 5 to 9 percent slopes, moderately eroded	2,830	1.0
99D2	Exira silty clay loam, 9 to 14 percent slopes, moderately eroded	26,365	9.8
99D3	Exira silty clay loam, 9 to 14 percent slopes, severely eroded	375	0.1
99E2	Exira silty clay loam, 14 to 18 percent slopes, moderately eroded	230	0.1
133	Colo silty clay loam, 0 to 2 percent slopes	4,840	1.8
133+	Colo silt loam, overwash, 0 to 2 percent slopes	6,095	2.3
134	Zook silty clay, 0 to 2 percent slopes	895	0.3
175D	Dickinson fine sandy loam, 9 to 14 percent slopes	230	0.1
179D	Gara loam, 9 to 14 percent slopes	455	0.2
179D2	Gara loam, 9 to 14 percent slopes, moderately eroded	2,075	0.8
179E	Gara loam, 14 to 18 percent slopes	1,005	0.4
179E2	Gara loam, 14 to 18 percent slopes, moderately eroded	1,675	0.6
179F	Gara loam, 18 to 25 percent slopes	1,260	0.5
192D2	Adair clay loam, 9 to 14 percent slopes, moderately eroded	1,895	0.7
212	Kennebec silt loam, 0 to 2 percent slopes	1,760	0.7
212+	Kennebec silt loam, overwash, 0 to 2 percent slopes	1,470	0.5
220	Nodaway silt loam, 0 to 2 percent slopes	11,335	4.2
222C2	Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded	285	0.1
222D2	Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded	5,820	2.2
269	Humeston silt loam, 0 to 2 percent slopes	370	0.1
273B	Olmitz loam, 2 to 5 percent slopes	515	0.2
273C	Olmitz loam, 5 to 9 percent slopes	305	0.1
318F2	Clanton silty clay loam, 12 to 20 percent slopes, moderately eroded	110	*
370B	Sharpsburg silty clay loam, 2 to 5 percent slopes	2,175	0.8
370C	Sharpsburg silty clay loam, 5 to 9 percent slopes	200	0.1
370C2	Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded	4,540	1.7
370D	Sharpsburg silty clay loam, 9 to 14 percent slopes	345	0.1
370D2	Sharpsburg silty clay loam, 9 to 14 percent slopes, moderately eroded	6,135	2.3
423D2	Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded	905	0.3
430	Ackmore silt loam, 0 to 2 percent slopes	1,980	0.7
509	Marshall silty clay loam, benches, 0 to 2 percent slopes	1,530	0.6
509B	Marshall silty clay loam, benches, 2 to 5 percent slopes	1,345	0.5
509C2	Marshall silty clay loam, benches, 5 to 9 percent slopes, moderately eroded	525	0.2
517D2	Hesch Variant loam, 9 to 14 percent slopes, moderately eroded	385	0.1
517E	Hesch Variant loam, 14 to 20 percent slopes	205	0.1

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
692D2	Mayberry silty clay loam, 5 to 14 percent slopes, moderately eroded	235	0.1
751D2	Northboro silty clay loam, 5 to 14 percent slopes, moderately eroded	330	0.1
822D2	Lamoni clay loam, 9 to 14 percent slopes, moderately eroded	4,165	1.5
870	Sharpsburg silty clay loam, benches, 0 to 2 percent slopes	480	0.2
870B	Sharpsburg silty clay loam, benches, 2 to 5 percent slopes	830	0.3
870C2	Sharpsburg silty clay loam, benches, 5 to 9 percent slopes, moderately eroded	345	0.1
1220	Nodaway silt loam, channeled, 0 to 2 percent slopes	1,265	0.5
1233	Corley silt loam, benches, 0 to 2 percent slopes	225	0.1
1299	Minden silty clay loam, benches, 0 to 2 percent slopes	915	0.3
1368	Macksburg silty clay loam, benches, 0 to 2 percent slopes	345	0.1
5010	Pits, sand and gravel	105	*
5030	Pits, limestone quarries	305	0.1
5040	Orthents, loamy	630	0.2
	Water	830	0.3
	Total	270,080	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
8B	Judson silty clay loam, 2 to 5 percent slopes
9	Marshall silty clay loam, 0 to 2 percent slopes
9B	Marshall silty clay loam, 2 to 5 percent slopes
11B	Ackmore-Colo-Judson complex, 2 to 5 percent slopes (where drained)
43	Bremer silty clay loam, 0 to 2 percent slopes (where drained)
54	Zook silty clay loam, 0 to 2 percent slopes (where drained)
54+	Zook silt loam, overwash, 0 to 2 percent slopes (where drained)
76B	Ladoga silt loam, 2 to 5 percent slopes
88	Nevin silty clay loam, 0 to 2 percent slopes
133	Colo silty clay loam, 0 to 2 percent slopes (where drained)
133+	Colo silt loam, overwash, 0 to 2 percent slopes (where drained)
134	Zook silty clay, 0 to 2 percent slopes (where drained)
212	Kennebec silt loam, 0 to 2 percent slopes
212+	Kennebec silt loam, overwash, 0 to 2 percent slopes
220	Nodaway silt loam, 0 to 2 percent slopes
269	Humeston silt loam, 0 to 2 percent slopes (where drained)
273B	Olmitz loam, 2 to 5 percent slopes
370B	Sharpsburg silty clay loam, 2 to 5 percent slopes
430	Ackmore silt loam, 0 to 2 percent slopes (where drained)
509	Marshall silty clay loam, benches, 0 to 2 percent slopes
509B	Marshall silty clay loam, benches, 2 to 5 percent slopes
870	Sharpsburg silty clay loam, benches, 0 to 2 percent slopes
870B	Sharpsburg silty clay loam, benches, 2 to 5 percent slopes
1233	Corley silt loam, benches, 0 to 2 percent slopes (where drained)
1299	Minden silty clay loam, benches, 0 to 2 percent slopes
1368	Macksburg silty clay loam, benches, 0 to 2 percent slopes

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
8B-------------- Judson	IIe	149	50	82	6.3	3.7	6.1	8.6
8C-------------- Judson	IIIe	144	48	79	6.1	3.5	5.9	8.3
9--------------- Marshall	I	153	51	84	6.4	3.8	6.3	7.6
9B-------------- Marshall	IIe	150	50	83	6.3	3.7	6.2	7.5
9C-------------- Marshall	IIIe	145	49	80	6.1	3.6	6.0	7.1
9C2------------- Marshall	IIIe	141	47	78	5.9	3.5	5.8	7.0
9D-------------- Marshall	IIIe	136	46	75	5.7	3.4	5.6	6.5
9D2------------- Marshall	IIIe	132	44	73	5.5	3.3	5.4	6.3
11B------------- Ackmore-Colo-Judson	IIw	140	47	77	4.2	3.4	5.7	7.5
24D------------- Shelby	IIIe	119	40	60	5.0	2.9	4.9	5.8
24D2------------ Shelby	IIIe	115	39	58	4.8	2.8	4.7	5.6
24E------------- Shelby	IVe	102	34	51	4.2	2.5	4.2	4.8
24E2------------ Shelby	IVe	98	33	49	4.1	2.4	4.0	4.5
24F------------- Shelby	VIe	---	---	---	2.9	2.3	3.8	---
33D2------------ Steinauer	IVe	102	34	51	4.3	2.5	4.2	---
33E2------------ Steinauer	VIe	---	---	---	3.6	2.1	3.5	---
43-------------- Bremer	IIw	136	46	68	4.1	3.4	5.6	7.5
54-------------- Zook	IIw	126	42	69	3.8	3.1	5.2	---
54+------------- Zook	IIw	131	44	72	3.9	3.2	5.4	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
60D2------------ Malvern	IVe	88	29	48	3.5	2.2	3.6	5.0
76B------------- Ladoga	IIe	144	48	72	6.1	3.5	5.9	7.8
76C------------- Ladoga	IIIe	139	47	70	5.8	3.4	5.7	7.5
76C2------------ Ladoga	IIIe	135	45	68	5.7	3.3	5.5	7.3
76D------------- Ladoga	IIIe	130	44	65	5.5	3.2	5.3	7.0
76D2------------ Ladoga	IIIe	126	42	63	5.3	3.1	5.2	6.6
88-------------- Nevin	I	153	51	84	6.1	3.8	6.3	8.0
93D2------------ Shelby-Adair	IVe	91	30	46	3.6	2.2	3.7	4.9
99C2------------ Exira	IIIe	136	46	75	5.7	3.4	5.6	---
99D2------------ Exira	IIIe	127	43	70	5.3	3.1	5.2	---
99D3------------ Exira	IVe	118	40	65	5.0	2.9	4.8	---
99E2------------ Exira	IVe	110	37	61	4.6	2.7	4.5	---
133------------- Colo	IIw	136	46	75	4.1	3.4	5.6	7.0
133+------------ Colo	IIw	140	47	77	4.2	3.4	5.7	7.0
134------------- Zook	IIIw	117	39	64	3.5	2.9	4.8	---
175D------------ Dickinson	IVe	95	32	52	4.0	2.3	3.9	3.8
179D------------ Gara	IVe	110	37	61	4.6	2.7	4.5	5.5
179D2----------- Gara	IVe	106	36	58	4.5	2.6	4.4	5.1
179E------------ Gara	VIe	---	---	---	3.9	2.3	3.8	4.1
179E2----------- Gara	VIe	---	---	---	3.7	2.2	3.7	3.8

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
179F------------ Gara	VIe	---	---	---	2.4	2.0	3.4	2.5
192D2----------- Adair	IVe	73	24	37	3.0	1.8	3.0	3.8
212, 212+------- Kennebec	I	155	52	85	6.5	3.8	6.4	8.5
220------------- Nodaway	IIw	145	49	80	6.1	3.6	6.0	7.6
222C2----------- Clarinda	IVw	72	24	36	2.2	1.8	3.0	3.6
222D2----------- Clarinda	IVe	63	21	32	1.9	1.5	2.6	3.0
269------------- Humeston	IIIw	110	37	55	3.3	2.7	4.5	6.1
273B------------ Olmitz	IIe	137	46	69	5.8	3.4	5.6	7.0
273C------------ Olmitz	IIIe	132	44	66	5.5	3.2	5.4	6.6
318F2----------- Clanton	VIIe	---	---	---	---	0.5	---	---
370B------------ Sharpsburg	IIe	153	51	77	6.4	3.8	6.3	7.8
370C------------ Sharpsburg	IIIe	148	50	74	6.2	3.6	6.1	7.5
370C2----------- Sharpsburg	IIIe	144	48	72	6.1	3.5	5.9	7.3
370D------------ Sharpsburg	IIIe	139	47	70	5.8	3.4	5.7	7.0
370D2----------- Sharpsburg	IIIe	135	45	68	5.7	3.3	5.5	6.6
423D2----------- Bucknell	IVe	64	21	32	2.6	1.6	2.6	4.1
430------------- Ackmore	IIw	141	47	71	4.2	3.5	5.8	7.5
509------------- Marshall	I	153	51	84	6.4	3.8	6.3	7.6
509B------------ Marshall	IIe	150	50	83	6.3	3.7	6.2	7.5
509C2----------- Marshall	IIIe	141	47	78	5.9	3.5	5.8	7.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
517D2----------- Hesch Variant	IIIe	82	27	45	3.4	3.7	3.4	4.0
517E------------ Hesch Variant	IVe	69	23	38	2.9	3.5	2.8	3.5
692D2----------- Mayberry	IVe	56	19	31	2.5	1.4	2.3	---
751D2----------- Northboro	IIIe	114	38	63	4.8	2.8	4.7	6.1
822D2----------- Lamoni	IVe	73	24	37	2.9	1.8	3.0	4.3
870------------- Sharpsburg	I	156	52	78	6.6	3.8	6.4	8.0
870B------------ Sharpsburg	IIe	153	51	77	6.4	3.8	6.3	7.8
870C2----------- Sharpsburg	IIIe	144	48	72	6.1	3.5	5.9	7.3
1220------------ Nodaway	Vw	---	---	---	---	3.0	---	---
1233------------ Corley	IIw	130	44	72	3.9	3.2	5.3	6.0
1299------------ Minden	I	161	54	89	6.4	4.0	6.6	7.3
1368------------ Macksburg	I	164	55	82	6.6	4.0	6.7	---
5010**, 5030**. Pits								
5040. Orthents								

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
8B, 8C Judson	---	Amur honeysuckle, Amur maple, autumn olive, lilac.	Hackberry, bur oak, green ash, Russian olive, eastern redcedar.	Honeylocust, Austrian pine, eastern white pine.	---
9, 9B, 9C, 9C2, 9D, 9D2 Marshall	---	Autumn olive, lilac, Amur maple, Amur honeysuckle.	Eastern redcedar, Russian olive, hackberry, bur oak, green ash.	Austrian pine, eastern white pine, honeylocust.	---
11B*:					
Ackmore	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Austrian pine, white fir, blue spruce, eastern arborvitae, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
Colo	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, white fir, eastern arborvitae, Washington hawthorn.	Eastern white pine	Pin oak.
Judson	---	Amur honeysuckle, Amur maple, autumn olive, lilac.	Hackberry, bur oak, green ash, Russian olive, eastern redcedar.	Honeylocust, Austrian pine, eastern white pine.	---
24D, 24D2, 24E, 24E2, 24F Shelby	---	Autumn olive, lilac, Amur honeysuckle, Amur maple.	Eastern redcedar, Russian olive, hackberry, bur oak, green ash.	Austrian pine, eastern white pine, honeylocust.	---
33D2 Steinauer	Fragrant sumac	Siberian peashrub	Northern catalpa, Russian olive, eastern redcedar, bur oak, black locust, Osageorange, green ash, honeylocust.	---	---
33E2. Steinauer					
43 Bremer	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, honeylocust, green ash, silver maple, golden willow, northern red oak.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
54, 54+: Zook	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Honeylocust, golden willow, green ash, northern red oak, silver maple, Austrian pine.	Eastern cottonwood.
60D2: Malvern	Lilac	Amur honeysuckle, Siberian peashrub, Manchurian crabapple, autumn olive.	Austrian pine, eastern redcedar, jack pine, Russian olive, green ash, hackberry.	Honeylocust	---
76B, 76C, 76C2, 76D, 76D2: Ladoga	---	Lilac, Amur honeysuckle, autumn olive, Amur maple.	Eastern redcedar, hackberry, green ash, bur oak, Russian olive.	Austrian pine, eastern white pine, honeylocust.	---
88: Nevin	---	Amur honeysuckle, lilac, autumn olive, Amur maple.	Eastern redcedar	Austrian pine, eastern white pine, honeylocust, hackberry, green ash, pin oak.	Eastern cottonwood.
93D2*:					
Shelby	---	Autumn olive, lilac, Amur honeysuckle, Amur maple.	Eastern redcedar, Russian olive, hackberry, bur oak, green ash.	Austrian pine, eastern white pine, honeylocust.	---
Adair	Lilac	Amur honeysuckle, Manchurian crabapple, autumn olive, Siberian crabapple.	Austrian pine, eastern redcedar, green ash, jack pine, Russian olive, hackberry.	Honeylocust	---
99C2, 99D2, 99D3, 99E2: Exira	---	Lilac, Amur honeysuckle, Amur maple, autumn olive.	Eastern redcedar, green ash, hackberry, bur oak, Russian olive.	Austrian pine, eastern white pine, honeylocust.	---
133, 133+: Colo	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, white fir, eastern arborvitae, Washington hawthorn.	Eastern white pine	Pin oak.
134: Zook	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Honeylocust, golden willow, green ash, northern red oak, silver maple, Austrian pine.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
175D Dickinson	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn olive, Amur honeysuckle, lilac.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
179D, 179D2, 179E, 179E2, 179F Gara	---	Autumn olive, lilac, Amur honeysuckle, Amur maple.	Bur oak, eastern redcedar, green ash, Russian olive, hackberry.	Honeylocust, eastern white pine, Austrian pine.	---
192D2 Adair	Lilac	Amur honeysuckle, Manchurian crabapple, autumn olive, Siberian crabapple.	Austrian pine, eastern redcedar, green ash, jack pine, Russian olive, hackberry.	Honeylocust	---
212, 212+ Kennebec	---	Amur maple, Amur honeysuckle, lilac, autumn olive.	Eastern redcedar	Austrian pine, hackberry, pin oak, green ash, honeylocust.	Eastern white pine, eastern cottonwood.
220 Nodaway	---	Amur honeysuckle, autumn olive, Amur maple, lilac.	Eastern redcedar	Austrian pine, hackberry, honeylocust, green ash, eastern white pine, pin oak.	Eastern cottonwood.
222C2, 222D2 Clarinda	Lilac	Manchurian crabapple, Amur honeysuckle, Siberian peashrub, autumn olive.	Eastern redcedar, Austrian pine, hackberry, green ash, jack pine, Russian olive.	Honeylocust	---
269 Humeston	Redosier dogwood	Common chokecherry, American plum.	Hackberry, eastern redcedar.	Northern red oak, honeylocust, green ash, golden willow, Austrian pine, silver maple.	Eastern cottonwood.
273B, 273C Olmitz	---	Amur maple, lilac, autumn olive, Amur honeysuckle.	Eastern redcedar, Russian olive, hackberry, bur oak, green ash.	Austrian pine, eastern white pine, honeylocust.	---
318F2 Clanton	---	Amur honeysuckle, Washington hawthorn, eastern redcedar, American cranberrybush, arrowwood, Amur privet.	Austrian pine, green ash, Osageorange.	Pin oak, eastern white pine.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
370B, 370C, 370C2, 370D, 370D2------ Sharpsburg	---	Amur maple, Amur honeysuckle, lilac, autumn olive.	Green ash, hackberry, bur oak, eastern redcedar, Russian olive.	Austrian pine, eastern white pine, honeylocust.	---
423D2------------ Bucknell	---	American cranberrybush, eastern redcedar, arrowwood, Washington hawthorn, Amur privet, Amur honeysuckle.	Green ash, Austrian pine, Osageorange.	Eastern white pine, pin oak.	---
430-------------- Ackmore	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Austrian pine, white fir, blue spruce, eastern arborvitae, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
509, 509B, 509C2-- Marshall	---	Autumn olive, lilac, Amur maple, Amur honeysuckle.	Eastern redcedar, Russian olive, hackberry, bur oak, green ash.	Austrian pine, eastern white pine, honeylocust.	---
517D2, 517E------- Hesch Variant	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn olive, Amur honeysuckle, lilac.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
692D2------------ Mayberry	Siberian peashrub, Amur honeysuckle, lilac.	Eastern redcedar, Manchurian crabapple, autumn olive.	Russian olive, Austrian pine, jack pine, green ash, hackberry, honeylocust.	---	---
751D2------------ Northboro	---	Lilac, Amur honeysuckle, autumn olive, Amur maple.	Bur oak, eastern redcedar, Russian olive, hackberry, green ash.	Eastern white pine, Austrian pine, honeylocust.	---
822D2------------ Lamoni	---	Eastern redcedar, Washington hawthorn, arrowwood, Amur honeysuckle, Amur privet, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
870, 870B, 870C2-- Sharpsburg	---	Amur maple, Amur honeysuckle, lilac, autumn olive.	Green ash, hackberry, bur oak, eastern redcedar, Russian olive.	Austrian pine, eastern white pine, honeylocust.	---
1220-------------- Nodaway	---	Amur honeysuckle, autumn olive, Amur maple, lilac.	Eastern redcedar	Austrian pine, hackberry, honeylocust, green ash, eastern white pine, pin oak.	Eastern cottonwood.
1233-------------- Corley	Redosier dogwood	Common chokecherry, American plum.	Hackberry, eastern redcedar.	Silver maple, honeylocust, golden willow, green ash, Austrian pine, northern red oak.	Eastern cottonwood.
1299-------------- Minden	---	Lilac, autumn olive, Amur honeysuckle, Amur maple.	Eastern redcedar	Green ash, eastern white pine, Austrian pine, pin oak, hackberry, honeylocust.	Eastern cottonwood.
1368-------------- Macksburg	---	Amur honeysuckle, lilac, autumn olive, Amur maple.	Eastern redcedar	Austrian pine, eastern white pine, honeylocust, hackberry, green ash, pin oak.	Eastern cottonwood.
5010*, 5030*. Pits					
5040. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
8B-------------------- Judson	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
8C-------------------- Judson	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
9--------------------- Marshall	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
9B-------------------- Marshall	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
9C, 9C2--------------- Marshall	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
9D, 9D2--------------- Marshall	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
11B*:					
Ackmore---------------	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Colo------------------	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Judson----------------	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
24D, 24D2------------- Shelby	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
24E, 24E2, 24F-------- Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
33D2------------------ Steinauer	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
33E2------------------ Steinauer	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
43-------------------- Bremer	Severe: wetness, flooding.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
54, 54+--------------- Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
60D2------------------ Malvern	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
76B------------------- Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
76C, 76C2------------ Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
76D, 76D2------------ Ladoga	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
88------------------- Nevin	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
93D2*:					
Shelby---------------	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
Adair----------------	Severe: wetness.	Moderate: wetness, slope, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
99C2----------------- Exira	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
99D2, 99D3----------- Exira	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
99E2----------------- Exira	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
133, 133+------------ Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
134------------------ Zook	Severe: flooding, wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
175D----------------- Dickinson	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
179D, 179D2---------- Gara	Moderate: percs slowly, slope.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
179E, 179E2, 179F----- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
192D2---------------- Adair	Severe: wetness.	Moderate: wetness, slope, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
212, 212+------------ Kennebec	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
220 Nodaway	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
222C2 Clarinda	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
222D2 Clarinda	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
269 Humeston	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
273B Olmitz	Slight	Slight	Moderate: slope.	Slight	Slight.
273C Olmitz	Slight	Slight	Severe: slope.	Slight	Slight.
318F2 Clanton	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
370B Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
370C, 370C2 Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Slight.
370D, 370D2 Sharpsburg	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
423D2 Bucknell	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
430 Ackmore	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
509 Marshall	Slight	Slight	Slight	Slight	Slight.
509B Marshall	Slight	Slight	Moderate: slope.	Slight	Slight.
509C2 Marshall	Slight	Slight	Severe: slope.	Slight	Slight.
517D2 Hesch Variant	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
517E Hesch Variant	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
692D2: Mayberry	Severe: wetness.	Moderate: slope, wetness.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
751D2: Northboro	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
822D2: Lamoni	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
870: Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Slight.
870B: Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
870C2: Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Slight.
1220: Nodaway	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
1233: Corley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1299: Minden	Slight	Slight	Slight	Slight	Slight.
1368: Macksburg	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Slight	Slight.
5010*, 5030*. Pits					
5040. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
8B----------------- Judson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
8C----------------- Judson	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
9, 9B-------------- Marshall	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
9C, 9C2, 9D, 9D2--- Marshall	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
11B*:										
Ackmore-----------	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Colo--------------	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Judson------------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
24D, 24D2---------- Shelby	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
24E, 24E2, 24F----- Shelby	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
33D2--------------- Steinauer	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
33E2--------------- Steinauer	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
43----------------- Bremer	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
54, 54+------------ Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
60D2--------------- Malvern	Fair	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
76B---------------- Ladoga	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
76C, 76C2, 76D, 76D2-------------- Ladoga	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
88----------------- Nevin	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
93D2*:										
Shelby------------	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Adair-------------	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
99C2, 99D2, 99D3, 99E2: Exira	Good	Good	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor.
133, 133+: Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
134: Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
175D: Dickinson	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
179D, 179D2: Gara	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
179E, 179E2, 179F: Gara	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
192D2: Adair	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
212, 212+: Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
220: Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
222C2, 222D2: Clarinda	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
269: Humeston	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
273B: Olmitz	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
273C: Olmitz	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
318F2: Clanton	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
370B: Sharpsburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
370C, 370C2, 370D, 370D2: Sharpsburg	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
423D2: Bucknell	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Very poor.
430: Ackmore	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
509, 509B: Marshall	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
509C2-------------- Marshall	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
517D2-------------- Hesch Variant	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
517E--------------- Hesch Variant	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
692D2-------------- Mayberry	Fair	Good	Fair	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.
751D2-------------- Northboro	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
822D2-------------- Lamoni	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
870, 870B---------- Sharpsburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
870C2-------------- Sharpsburg	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
1220--------------- Nodaway	Poor	Fair	Fair	Poor	Poor	Good	Fair	Poor	Poor	Fair.
1233--------------- Corley	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
1299--------------- Minden	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1368--------------- Macksburg	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
5010*, 5030*. Pits										
5040. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
8B Judson	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
8C Judson	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
9, 9B Marshall	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
9C, 9C2 Marshall	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
9D, 9D2 Marshall	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
11B*:						
Ackmore	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
Colo	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
Judson	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
24D, 24D2 Shelby	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
24E, 24E2, 24F Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
33D2 Steinauer	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
33E2 Steinauer	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
43 Bremer	Severe: wetness.	Severe: wetness, shrink-swell, flooding.	Severe: wetness, shrink-swell, flooding.	Severe: wetness, shrink-swell, flooding.	Severe: shrink-swell, low strength, flooding.	Moderate: wetness, flooding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
54, 54+----------- Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
60D2-------------- Malvern	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness, slope.
76B--------------- Ladoga	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
76C, 76C2--------- Ladoga	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
76D, 76D2--------- Ladoga	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
88---------------- Nevin	Severe: wetness.	Severe: flooding.	Severe: wetness, flooding.	Severe: flooding.	Severe: frost action, low strength.	Slight.
93D2*:						
Shelby-----------	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Adair------------	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: slope, wetness.
99C2-------------- Exira	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
99D2, 99D3-------- Exira	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
99E2-------------- Exira	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, frost action, slope.	Severe: slope.
133, 133+--------- Colo	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
134--------------- Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, too clayey.
175D-------------- Dickinson	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
179D, 179D2: Gara	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
179E, 179E2, 179F: Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
192D2: Adair	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: slope, wetness.
212, 212+: Kennebec	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
220: Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
222C2: Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
222D2: Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: wetness, slope.
269: Humeston	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, wetness, low strength.	Severe: wetness.
273B: Olmitz	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
273C: Olmitz	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
318F2: Clanton	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
370B: Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
370C, 370C2: Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
370D, 370D2: Sharpsburg	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
423D2: Bucknell	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
430: Ackmore	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
509, 509B: Marshall	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
509C2: Marshall	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
517D2: Hesch Variant	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
517E: Hesch Variant	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
692D2: Mayberry	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness, slope.
751D2: Northboro	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
822D2: Lamoni	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
870, 870B: Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
870C2: Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
1220: Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Severe: flooding.
1233: Corley	Severe: ponding.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
1299: Minden	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1368--------------- Macksburg	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
5010*, 5030*. Pits						
5040. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
8B: Judson	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
8C: Judson	Slight	Severe: slope.	Slight	Slight	Good.
9: Marshall	Slight	Moderate: seepage.	Slight	Slight	Good.
9B: Marshall	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
9C, 9C2: Marshall	Slight	Severe: slope.	Slight	Slight	Good.
9D, 9D2: Marshall	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
11B*:					
Ackmore	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness, hard to pack.
Colo	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
Judson	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
24D, 24D2: Shelby	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
24E, 24E2, 24F: Shelby	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
33D2: Steinauer	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Poor: hard to pack.
33E2: Steinauer	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: hard to pack, slope.
43: Bremer	Severe: percs slowly, flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding, too clayey.	Severe: wetness, flooding.	Poor: wetness, hard to pack, too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
54, 54+ Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
60D2 Malvern	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
76B Ladoga	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
76C, 76C2 Ladoga	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
76D, 76D2 Ladoga	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
88 Nevin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
93D2*:					
Shelby	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
Adair	Severe: percs slowly, wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
99C2 Exira	Slight	Severe: slope.	Slight	Slight	Good.
99D2, 99D3 Exira	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
99E2 Exira	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
133, 133+ Colo	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
134 Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
175D Dickinson	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
179D, 179D2 Gara	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
179E, 179E2, 179F--- Gara	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
192D2--------------- Adair	Severe: percs slowly, wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
212, 212+----------- Kennebec	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
220----------------- Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
222C2, 222D2-------- Clarinda	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
269----------------- Humeston	Severe: wetness, percs slowly, flooding.	Severe: flooding.	Severe: wetness, too clayey, flooding.	Severe: wetness, flooding.	Poor: wetness, too clayey, hard to pack.
273B---------------- Olmitz	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
273C---------------- Olmitz	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
318F2--------------- Clanton	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
370B---------------- Sharpsburg	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
370C, 370C2--------- Sharpsburg	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
370D, 370D2--------- Sharpsburg	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
423D2--------------- Bucknell	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
430----------------- Ackmore	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness, hard to pack.
509----------------- Marshall	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Good.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
509B----------------- Marshall	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
509C2---------------- Marshall	Slight-----------	Severe: slope.	Slight-----------	Slight-----------	Good.
517D2---------------- Hesch Variant	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
517E----------------- Hesch Variant	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, seepage, too sandy.	Severe: seepage, slope.	Poor: slope, seepage, too sandy.
692D2---------------- Mayberry	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
751D2---------------- Northboro	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: slope, too clayey.
822D2---------------- Lamoni	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
870------------------ Sharpsburg	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
870B----------------- Sharpsburg	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
870C2---------------- Sharpsburg	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
1220----------------- Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
1233----------------- Corley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
1299----------------- Minden	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
1368----------------- Macksburg	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
5010*, 5030*. Pits					
5040. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
8B, 8C: Judson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
9, 9B, 9C, 9C2: Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
9D, 9D2: Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
11B*:				
Ackmore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
Colo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Judson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
24D, 24D2: Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, slope.
24E, 24E2, 24F: Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
33D2: Steinauer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, large stones, slope.
33E2: Steinauer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
43: Bremer	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
54, 54+: Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
60D2: Malvern	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
76B, 76C, 76C2, 76D, 76D2: Ladoga	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
88: Nevin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
93D2*:				
Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, slope.
Adair	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
99C2 Exira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
99D2, 99D3 Exira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
99E2 Exira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
133, 133+ Colo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
134 Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
175D Dickinson	Good	Probable	Improbable: too sandy.	Fair: slope.
179D, 179D2 Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
179E, 179E2, 179F Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
192D2 Adair	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
212, 212+ Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
220 Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
222C2, 222D2 Clarinda	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
269 Humeston	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
273B, 273C Olmitz	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
318F2 Clanton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
370B, 370C, 370C2, 370D, 370D2 Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
423D2 Bucknell	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
430 Ackmore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
509, 509B, 509C2 Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
517D2 Hesch Variant	Good	Probable	Probable	Fair: small stones, area reclaim, slope.
517E Hesch Variant	Fair: slope.	Probable	Probable	Poor: slope.
692D2 Mayberry	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
751D2 Northboro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
822D2 Lamoni	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
870, 870B, 870C2 Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
1220 Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1233 Corley	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1299 Minden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1368 Macksburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
5010*, 5030*. Pits				
5040. Orthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
8B, 8C Judson	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
9 Marshall	Moderate: seepage.	Slight	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
9B, 9C, 9C2 Marshall	Moderate: seepage, slope.	Slight	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
9D, 9D2 Marshall	Severe: slope.	Slight	Severe: no water.	Deep to water	Erodes easily, slope.	Slope, erodes easily.
11B*:						
Ackmore	Moderate: seepage.	Severe: hard to pack, wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, erodes easily.	Wetness, erodes easily.
Colo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness	Wetness.
Judson	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
24D, 24D2, 24E, 24E2, 24F Shelby	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope	Slope.
33D2, 33E2 Steinauer	Severe: slope.	Moderate: piping, hard to pack.	Severe: no water.	Deep to water	Slope	Slope, rooting depth.
43 Bremer	Slight	Severe: wetness, hard to pack.	Severe: slow refill.	Flooding, frost action.	Wetness	Wetness.
54, 54+ Zook	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
60D2 Malvern	Severe: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
76B, 76C, 76C2 Ladoga	Moderate: seepage, slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
76D, 76D2 Ladoga	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
88 Nevin	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action	Erodes easily, wetness.	Erodes easily.
93D2*: Shelby	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope	Slope.
Adair	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, slope, frost action.	Slope, wetness.	Wetness, slope, percs slowly.
99C2 Exira	Moderate: seepage, slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
99D2, 99D3, 99E2 Exira	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
133, 133+ Colo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness	Wetness.
134 Zook	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
175D Dickinson	Severe: slope, seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope.
179D, 179D2, 179E, 179E2, 179F Gara	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope	Slope.
192D2 Adair	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, slope, frost action.	Slope, wetness.	Wetness, slope, percs slowly.
212, 212+ Kennebec	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable	Favorable.
220 Nodaway	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
222C2 Clarinda	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Wetness, erodes easily.
222D2 Clarinda	Severe: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
269 Humeston	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action, flooding.	Wetness, percs slowly.	Percs slowly, wetness.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
273B, 273C-------- Olmitz	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Favorable------	Favorable.
318F2------------- Clanton	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
370B, 370C, 370C2- Sharpsburg	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
370D, 370D2------- Sharpsburg	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
423D2------------- Bucknell	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness, percs slowly.	Wetness, slope, percs slowly.
430--------------- Ackmore	Moderate: seepage.	Severe: hard to pack, wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, erodes easily.	Wetness, erodes easily.
509--------------- Marshall	Moderate: seepage.	Slight---------	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
509B, 509C2------- Marshall	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
517D2, 517E------- Hesch Variant	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, too sandy.	Slope.
692D2------------- Mayberry	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
751D2------------- Northboro	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
822D2------------- Lamoni	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.
870--------------- Sharpsburg	Moderate: seepage.	Slight---------	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
870B, 870C2------- Sharpsburg	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
1220-------------- Nodaway	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
1233-------------- Corley	Moderate: seepage.	Severe: ponding.	Moderate: slow refill.	Ponding, frost action.	Erodes easily, ponding.	Wetness, erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
1299 Minden	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
1368 Macksburg	Moderate: seepage.	Moderate: wetness.	Severe: slow refill.	Frost action	Erodes easily, wetness.	Erodes easily.
5010*, 5030*. Pits						
5040. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
8B, 8C----------- Judson	0-26	Silty clay loam	CL, ML	A-6, A-7	0	100	100	100	95-100	35-50	10-25
	26-60	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	30-50	15-25
9, 9B, 9C, 9C2, 9D, 9D2--------- Marshall	0-17	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	17-53	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	53-60	Silt loam, silty clay loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
11B*:											
Ackmore---------	0-9	Silt loam--------	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	8-20
	9-28	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	8-20
	28-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	85-100	35-60	15-30
Colo------------	0-16	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	16-43	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	43-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
Judson----------	0-26	Silty clay loam	CL, ML	A-6, A-7	0	100	100	100	95-100	35-50	10-25
	26-60	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	30-50	15-25
24D, 24D2, 24E, 24E2, 24F------- Shelby	0-7	Loam-------------	CL	A-6	0	95-100	85-100	75-90	55-70	30-40	10-20
	7-53	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-100	75-90	55-70	30-45	15-25
	53-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
33D2, 33E2------- Steinauer	0-6	Clay loam--------	CL	A-6, A-7	0-5	95-100	95-100	85-100	55-90	30-50	15-25
	6-20	Clay loam--------	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-55	12-30
	20-60	Loam, clay loam	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	60-75	25-55	10-30
43--------------- Bremer	0-17	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-60	25-40
	17-48	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	100	95-100	50-65	20-35
	48-60	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	40-60	25-40
54--------------- Zook	0-16	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	16-52	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	52-60	Silty clay loam, silty clay, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	95-100	35-80	10-50
54+-------------- Zook	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	12-29	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	29-60	Silty clay loam, silty clay, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	95-100	35-80	10-50
60D2------------- Malvern	0-12	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	12-60	Silty clay-------	CH	A-7	0	100	100	100	95-100	55-80	30-45

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
76B, 76C, 76C2, 76D, 76D2------- Ladoga	0-9	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	9-54	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	54-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
88-------------- Nevin	0-24	Silty clay loam	CL, OL	A-6, A-7	0	100	100	100	90-95	35-45	10-20
	24-53	Silty clay loam	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
	53-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
93D2*: Shelby----------	0-7	Loam-------------	CL	A-6	0	95-100	85-95	75-90	55-70	30-40	10-20
	7-48	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	48-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
Adair-----------	0-8	Clay loam--------	CL	A-6	0	95-100	80-100	75-90	60-80	30-40	10-20
	8-31	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	31-60	Clay loam--------	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
99C2, 99D2------- Exira	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	9-41	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	41-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
99D3------------ Exira	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	6-30	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	30-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
99E2------------ Exira	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	7-29	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	29-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
133------------- Colo	0-16	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	16-43	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	43-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
133+------------ Colo	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	12-55	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	55-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
134------------- Zook	0-7	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	7-35	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	35-60	Silty clay loam, silty clay, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	95-100	35-80	10-50

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
175D------------- Dickinson	0-7	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	7-31	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	31-38	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
	38-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
179D, 179D2, 179E, 179E2, 179F------------ Gara	0-11	Loam-------------	CL, CL-ML	A-4, A-6	0	95-100	85-100	75-85	55-70	20-30	5-15
	11-37	Clay loam, loam	CL	A-6	0-5	90-95	85-100	70-85	55-75	30-40	15-25
	37-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-100	70-85	55-75	35-45	15-25
192D2------------ Adair	0-8	Clay loam--------	CL	A-6	0	95-100	80-100	75-90	60-80	30-40	10-20
	8-31	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	31-60	Clay loam--------	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
212-------------- Kennebec	0-36	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
	36-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
212+------------- Kennebec	0-12	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
	12-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
220-------------- Nodaway	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
	8-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-40	5-15
222C2, 222D2----- Clarinda	0-9	Silty clay loam	CL	A-7	0	100	95-100	90-100	85-100	40-50	20-30
	9-35	Silty clay, clay	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
	35-60	Clay, silty clay	CH	A-7	0	95-100	95-100	80-95	75-90	55-70	35-45
269-------------- Humeston	0-10	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	10-16	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	95-100	95-100	25-40	5-15
	16-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	45-55	25-35
273B, 273C------- Olmitz	0-17	Loam-------------	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
	17-39	Loam, clay loam	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
	39-60	Clay loam--------	CL	A-6, A-7	0	100	90-100	85-95	60-80	35-45	15-25
318F2------------ Clanton	0-6	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	6-33	Silty clay loam, silty clay, clay.	CH, CL	A-7	0	100	100	95-100	85-100	40-55	25-35
	33-60	Silty clay loam, silty clay, clay.	CH, CL	A-7	0-10	90-100	90-100	90-100	85-100	40-55	25-35

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
370B, 370C, 370C2, 370D, 370D2----------- Sharpsburg	0-17	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	18-32
	17-36	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	36-52	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
	52-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
423D2------------ Bucknell	0-8	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	8-37	Clay, clay loam	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	37-60	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	70-90	55-85	35-50	15-30
430-------------- Ackmore	0-9	Silt loam--------	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	8-20
	9-28	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	8-20
	28-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	85-100	35-60	15-30
509, 509B, 509C2- Marshall	0-17	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	17-53	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	53-60	Silt loam, silty clay loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
517D2, 517E------ Hesch Variant	0-7	Loam-------------	CL, CL-ML	A-4	0	95-100	80-100	75-95	50-75	<25	5-10
	7-29	Clay loam, loam, sandy loam.	CL, SC, SM-SC, CL-ML	A-4, A-2	0	95-100	80-100	50-75	25-75	<25	5-10
	29-38	Loamy sand-------	SM, SM-SC, SP-SM	A-2, A-1, A-3	0	95-100	80-100	40-75	5-35	<20	NP-5
	38-60	Sand-------------	SP-SM, SW, SP, SM	A-1	0-5	70-90	70-85	20-40	3-15	---	NP
692D2------------ Mayberry	0-8	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	75-100	35-50	15-25
	8-52	Clay, sandy clay	CL, CH	A-7	0	100	90-100	80-100	60-100	45-65	25-40
	52-60	Stratified sandy loam to clay.	CL, CH	A-6, A-7	0	95-100	95-100	85-100	70-95	35-60	15-35
751D2------------ Northboro	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-95	35-50	15-25
	8-37	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	70-85	35-50	15-25
	37-60	Clay loam, loam	CL	A-7, A-6	0	95-100	95-100	85-100	65-80	35-50	15-25
822D2------------ Lamoni	0-8	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	8-31	Clay loam, clay	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	31-60	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	70-90	55-85	35-50	15-30
870, 870B, 870C2- Sharpsburg	0-13	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	18-32
	13-36	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	36-51	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
	51-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
1220------------- Nodaway	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
	8-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-40	5-15

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1233------------- Corley	0-19	Silt loam--------	CL	A-6, A-7	0	100	100	100	95-100	30-45	15-25
	19-60	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	35-55	20-30
1299------------- Minden	0-21	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	21-49	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	49-60	Silt loam, silty clay loam.	CL, ML	A-7, A-6	0	100	100	100	95-100	35-50	10-25
1368------------- Macksburg	0-23	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	23-28	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	28-43	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
	43-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-50	20-30
5010*, 5030*. Pits											
5040. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group
	In	Pct	g/cc	In/hr	In/in	pH				
8B, 8C----------- Judson	0-26	27-32	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	26-60	30-35	1.35-1.45	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.43		
9, 9B, 9C, 9C2, 9D, 9D2--------- Marshall	0-17	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
	17-53	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	53-60	22-30	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate-----	0.43		
11B*:										
Ackmore---------	0-9	25-27	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.37	5	6
	9-28	25-30	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.37		
	28-60	26-38	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.8	High---------	0.37		
Colo------------	0-16	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	16-43	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28		
	43-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.28		
Judson----------	0-26	27-32	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	26-60	30-35	1.35-1.45	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.43		
24D, 24D2, 24E, 24E2, 24F------- Shelby	0-7	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.1-7.3	Moderate-----	0.28	5	6
	7-53	30-35	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28		
	53-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
33D2, 33E2------- Steinauer	0-6	27-32	1.30-1.60	0.2-0.6	0.17-0.19	7.4-8.4	Moderate-----	0.32	5	4L
	6-20	27-32	1.30-1.60	0.2-0.6	0.15-0.17	7.9-8.4	Moderate-----	0.32		
	20-60	24-35	1.50-1.80	0.2-0.6	0.14-0.19	7.9-8.4	Moderate-----	0.32		
43-------------- Bremer	0-17	27-32	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	17-48	35-42	1.30-1.40	0.2-0.6	0.15-0.17	5.6-6.5	High---------	0.28		
	48-60	32-38	1.40-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High---------	0.28		
54-------------- Zook	0-16	32-38	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High---------	0.28	5	7
	16-52	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.28		
	52-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High---------	0.28		
54+------------- Zook	0-12	20-26	1.30-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	6
	12-29	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.28		
	29-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High---------	0.28		
60D2------------ Malvern	0-12	28-34	1.30-1.40	0.2-0.6	0.21-0.23	5.6-7.3	Moderate-----	0.37	3	7
	12-60	40-50	1.40-1.50	0.06-0.2	0.12-0.14	6.1-7.3	High---------	0.37		
76B, 76C, 76C2, 76D, 76D2------- Ladoga	0-9	18-27	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.32	5	6
	9-54	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	54-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43		
88-------------- Nevin	0-24	27-29	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
	24-53	30-35	1.30-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	53-60	25-36	1.40-1.45	0.6-2.0	0.18-0.20	6.6-7.3	Moderate-----	0.43		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group
	In	Pct	g/cc	In/hr	In/in	pH				
93D2*:										
Shelby----------	0-7	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.1-7.3	Moderate-----	0.28	5	6
	7-48	30-35	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28		
	48-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
Adair-----------	0-8	35-42	1.45-1.50	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.32	3	4
	8-31	38-60	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32		
	31-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
99C2, 99D2------- Exira	0-9	28-34	1.25-1.35	0.6-2.0	0.21-0.23	5.6-6.5	Moderate-----	0.32	5	7
	9-41	25-35	1.30-1.35	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43		
	41-60	20-30	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43		
99D3------------ Exira	0-6	28-34	1.25-1.35	0.6-2.0	0.21-0.23	5.6-6.5	Moderate-----	0.32	4	7
	6-30	25-35	1.30-1.35	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43		
	30-60	20-30	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43		
99E2------------ Exira	0-7	28-34	1.25-1.35	0.6-2.0	0.21-0.23	5.6-6.5	Moderate-----	0.32	5	7
	7-29	25-35	1.30-1.35	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43		
	29-60	20-30	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43		
133------------- Colo	0-16	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	16-43	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28		
	43-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.28		
133+------------ Colo	0-12	20-26	1.25-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	6
	12-55	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28		
	55-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.28		
134------------- Zook	0-7	40-44	1.35-1.40	0.06-0.2	0.11-0.13	5.6-7.3	High---------	0.28	5	4
	7-35	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.28		
	35-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High---------	0.28		
175D------------ Dickinson	0-7	10-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low----------	0.20	4	3
	7-31	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low----------	0.20		
	31-38	4-10	1.55-1.65	6.0-20	0.08-0.10	5.1-6.5	Low----------	0.20		
	38-60	4-10	1.60-1.70	6.0-20	0.02-0.04	5.6-6.5	Low----------	0.15		
179D, 179D2, 179E, 179E2, 179F----------- Gara	0-11	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	5	6
	11-37	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.28		
	37-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
192D2----------- Adair	0-8	35-42	1.45-1.50	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.32	3	4
	8-31	38-60	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32		
	31-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
212------------- Kennebec	0-36	22-27	1.25-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	6
	36-60	24-28	1.35-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.43		
212+------------ Kennebec	0-12	22-27	1.25-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	6
	12-60	24-28	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43		
220------------- Nodaway	0-8	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low----------	0.37	5	6
	8-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.37		
222C2, 222D2----- Clarinda	0-9	30-38	1.45-1.50	0.2-0.6	0.17-0.19	5.1-7.3	Moderate-----	0.37	3	7
	9-35	40-60	1.45-1.60	<0.06	0.14-0.16	5.1-6.5	High---------	0.37		
	35-60	40-60	1.50-1.60	<0.06	0.14-0.16	5.6-8.4	High---------	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi-bility group
								K	T	
	In	Pct	g/cc	In/hr	In/in	pH				
269--------------	0-10	24-27	1.35-1.40	0.6-2.0	0.21-0.23	5.1-7.3	Low----------	0.32	4	6
Humeston	10-16	20-26	1.30-1.35	0.2-2.0	0.20-0.22	4.5-6.0	Moderate-----	0.32		
	16-60	30-48	1.35-1.50	<0.06	0.13-0.15	4.5-6.5	High---------	0.32		
273B, 273C-------	0-17	24-27	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6
Olmitz	17-39	24-30	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28		
	39-60	28-34	1.45-1.55	0.6-2.0	0.15-0.17	5.1-6.5	Moderate-----	0.28		
318F2------------	0-6	27-30	1.45-1.50	0.6-2.0	0.22-0.24	4.5-7.3	Moderate-----	0.37	3	7
Clanton	6-33	38-48	1.50-1.70	<0.06	0.11-0.13	3.6-6.0	High---------	0.37		
	33-60	35-50	1.50-1.70	<0.06	0.11-0.15	3.6-7.3	High---------	0.37		
370B, 370C, 370C2, 370D, 370D2-----------	0-17	27-34	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	7
Sharpsburg	17-36	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	36-52	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43		
	52-60	25-32	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43		
423D2------------	0-8	27-38	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate-----	0.32	3	6
Bucknell	8-37	38-50	1.55-1.65	<0.06	0.13-0.17	4.5-6.5	High---------	0.32		
	37-60	30-40	1.60-1.70	0.06-0.2	0.14-0.18	5.6-7.3	High---------	0.32		
430--------------	0-9	25-27	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.37	5	6
Ackmore	9-28	25-30	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.37		
	28-60	26-38	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.8	High---------	0.37		
509, 509B, 509C2-	0-17	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
Marshall	17-53	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	53-60	22-30	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate-----	0.43		
517D2, 517E------	0-7	7-20	1.40-1.70	0.6-2.0	0.18-0.22	5.1-6.5	Low----------	0.24	4	5
Hesch Variant	7-29	15-30	1.50-1.70	0.6-2.0	0.16-0.20	5.1-6.5	Low----------	0.20		
	29-38	1-12	1.55-1.70	6.0-20	0.05-0.14	4.5-6.5	Low----------	0.20		
	38-60	1-5	1.55-1.70	6.0-20	0.05-0.10	4.5-6.5	Low----------	0.20		
692D2------------	0-8	27-40	1.40-1.50	0.2-0.6	0.17-0.23	5.6-6.5	Moderate-----	0.37	3	6
Mayberry	8-52	40-50	1.50-1.65	0.06-0.2	0.10-0.11	5.6-7.8	High---------	0.37		
	52-60	18-45	1.40-1.50	0.06-0.2	0.09-0.16	6.1-8.4	Moderate-----	0.37		
751D2------------	0-8	27-30	1.35-1.40	0.6-2.0	0.18-0.22	5.6-7.3	Moderate-----	0.32	5	7
Northboro	8-37	24-35	1.40-1.60	0.6-2.0	0.17-0.21	5.6-6.5	Moderate-----	0.43		
	37-60	24-30	1.60-1.80	0.2-0.6	0.12-0.16	6.1-7.3	Moderate-----	0.43		
822D2------------	0-8	27-40	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate-----	0.32	2	6
Lamoni	8-31	38-50	1.55-1.65	0.06-0.2	0.13-0.17	5.1-6.5	High---------	0.32		
	31-60	32-40	1.60-1.70	0.06-0.2	0.14-0.18	5.6-7.3	High---------	0.32		
870, 870B, 870C2-	0-13	27-34	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	7
Sharpsburg	13-36	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	36-51	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43		
	51-60	25-32	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43		
1220-------------	0-8	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low----------	0.37	5	6
Nodaway	8-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.37		
1233-------------	0-19	20-27	1.25-1.30	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.28	5	6
Corley	19-60	26-32	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.5	High---------	0.43		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group
	In	Pct	g/cc	In/hr	In/in	pH				
1299------------- Minden	0-21	27-32	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	21-49	29-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	49-60	22-30	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.43		
1368------------- Macksburg	0-23	27-34	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	7
	23-28	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	High---------	0.43		
	28-43	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43		
	43-60	25-32	1.40-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43		
5010*, 5030*. Pits										
5040. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft					
8B, 8C------------ Judson	B	None--------	---	---	>6.0	---	---	High-----	Moderate	Low.
9, 9B, 9C, 9C2, 9D, 9D2---------- Marshall	B	None--------	---	---	>6.0	---	---	High-----	Moderate	Moderate.
11B*:										
Ackmore----------	B	Occasional	Very brief to brief.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Low.
Colo-------------	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
Judson-----------	B	None--------	---	---	>6.0	---	---	High-----	Moderate	Low.
24D, 24D2, 24E, 24E2, 24F-------- Shelby	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
33D2, 33E2-------- Steinauer	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
43---------------- Bremer	C	Occasional	Very brief	Feb-Nov	1.0-2.0	Apparent	Nov-Jul	High-----	Moderate	Moderate.
54, 54+----------- Zook	C/D	Occasional	Brief to long.	Feb-Nov	0-3.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
60D2-------------- Malvern	C	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
76B, 76C, 76C2, 76D, 76D2-------- Ladoga	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
88---------------- Nevin	B	Rare--------	---	---	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Low.
93D2*:										
Shelby-----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Adair------------	C	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
99C2, 99D2, 99D3, 99E2------------ Exira	B	None--------	---	---	>6.0	---	---	High-----	Moderate	Moderate.
133, 133+--------- Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
134--------------- Zook	C/D	Occasional	Brief to long.	Feb-Nov	0-3.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
175D-------------- Dickinson	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
179D, 179D2, 179E, 179E2, 179F------ Gara	C	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
192D2------------ Adair	C	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
212, 212+--------- Kennebec	B	Occasional	Brief-----	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	High-----	Moderate	Low.
220--------------- Nodaway	B	Occasional	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	High-----	Moderate	Low.
222C2, 222D2------ Clarinda	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
269--------------- Humeston	C/D	Occasional	Very brief	Feb-Nov	0-1.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
273B, 273C-------- Olmitz	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
318F2------------ Clanton	C	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
370B, 370C, 370C2, 370D, 370D2------ Sharpsburg	B	None--------	---	---	>6.0	---	---	High-----	Moderate	Moderate.
423D2------------ Bucknell	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	Moderate	High-----	Moderate.
430--------------- Ackmore	B	Occasional	Very brief to brief.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Low.
509, 509B, 509C2-- Marshall	B	None--------	---	---	>6.0	---	---	High-----	Moderate	Moderate.
517D2, 517E------- Hesch Variant	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Moderate.
692D2------------ Mayberry	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Low.
751D2------------ Northboro	C	None--------	---	---	>6.0	---	---	High-----	Moderate	Moderate.
822D2------------ Lamoni	C	None--------	---	---	1.0-3.0	Perched	Nov-Jul	Moderate	High-----	Moderate.
870, 870B, 870C2-- Sharpsburg	B	None--------	---	---	>6.0	---	---	High-----	Moderate	Moderate.
1220-------------- Nodaway	B	Frequent----	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	High-----	Moderate	Low.
1233-------------- Corley	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
1299-------------- Minden	B	None--------	---	---	3.0-5.0	Apparent	Nov-Jul	High-----	High-----	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft					
1368-------------- Macksburg	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
5010*, 5030*. Pits										
5040. Orthents										

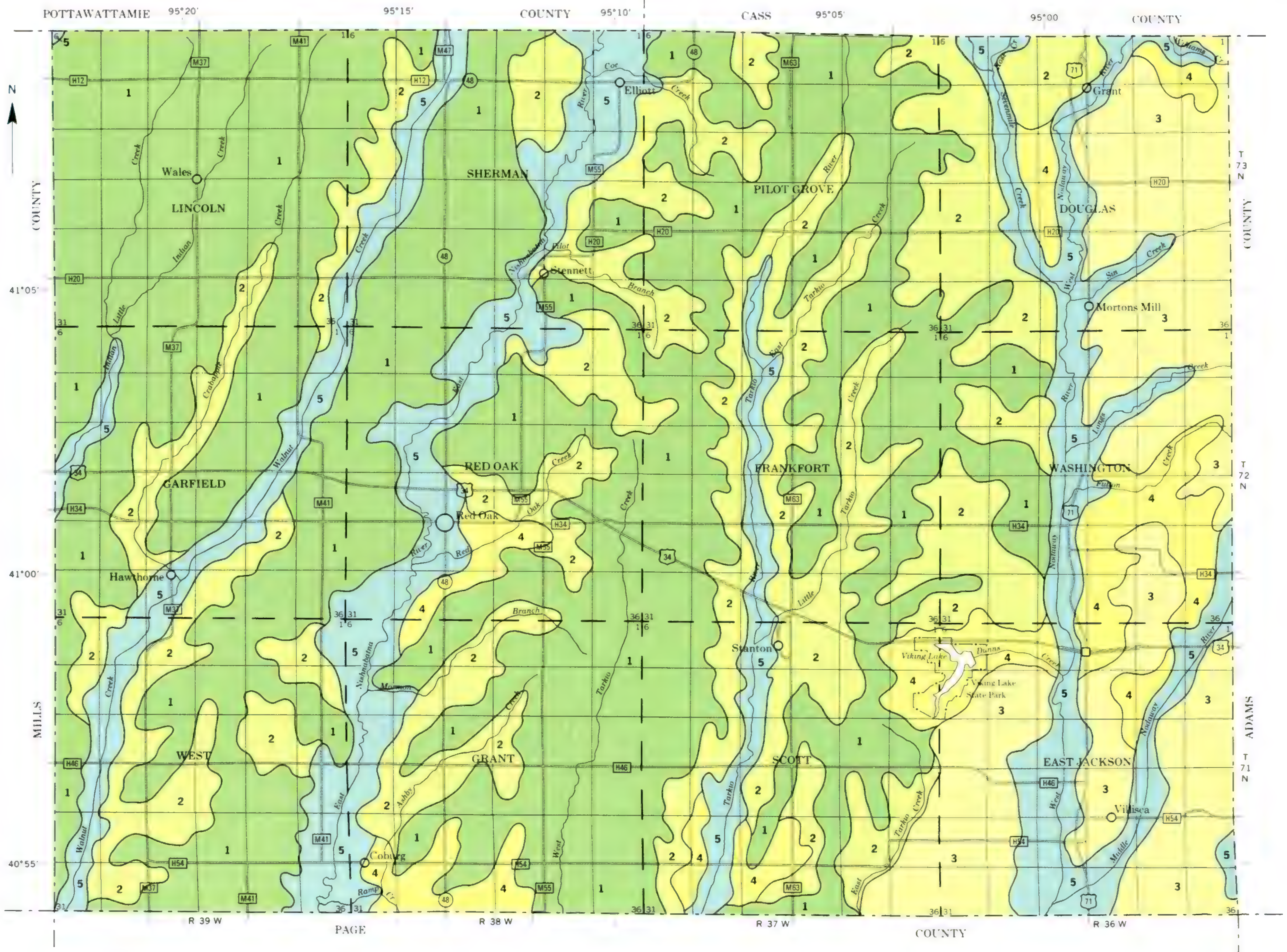
* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Ackmore	Fine-silty, mixed, nonacid, mesic Aeric Fluvaquents
*Adair	Fine, montmorillonitic, mesic Aquic Argiudolls
Bremer	Fine, montmorillonitic, mesic Typic Argiaquolls
Bucknell	Fine, montmorillonitic, mesic, sloping Udollic Ochraqualfs
*Clanton	Fine, illitic, mesic Mollic Hapludalfs
*Clarinda	Fine, montmorillonitic, mesic, sloping Typic Argiaquolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Corley	Fine-silty, mixed, mesic Argiaquic Argialbolls
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
*Exira	Fine-silty, mixed, mesic Typic Hapludolls
Gara	Fine-loamy, mixed, mesic Mollic Hapludalfs
Hesch Variant	Fine-loamy, mixed, mesic Mollic Hapludalfs
Humeston	Fine, montmorillonitic, mesic Argiaquic Argialbolls
Judson	Fine-silty, mixed, mesic Cumulic Hapludolls
Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
Ladoga	Fine, montmorillonitic, mesic Mollic Hapludalfs
*Lamoni	Fine, montmorillonitic, mesic Aquic Argiudolls
Macksburg	Fine, montmorillonitic, mesic Aquic Argiudolls
*Malvern	Fine, montmorillonitic, mesic Aquic Argiudolls
Marshall	Fine-silty, mixed, mesic Typic Hapludolls
*Mayberry	Fine, montmorillonitic, mesic Aquic Argiudolls
Minden	Fine-silty, mixed, mesic Aquic Hapludolls
Nevin	Fine-silty, mixed, mesic Aquic Argiudolls
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
*Northboro	Fine-silty, mixed, mesic Typic Hapludolls
Olmitz	Fine-loamy, mixed, mesic Cumulic Hapludolls
Orthents	Loamy, mixed, mesic Udorthents
Sharpsburg	Fine, montmorillonitic, mesic Typic Argiudolls
Shelby	Fine-loamy, mixed, mesic Typic Argiudolls
Steinauer	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

NRCS Accessibility Statement



LEGEND*

- **1** — MARSHALL-EXIRA ASSOCIATION: Nearly level to moderately steep, well drained, silty soils formed in loess; on uplands
- **2** — MARSHALL-SHELBY ASSOCIATION: Gently sloping to steep, well drained and moderately well drained, silty and loamy soils formed in loess and glacial till; on uplands and benches
- **3** — SHARPSBURG-SHELBY ASSOCIATION: Gently sloping to steep, moderately well drained, silty and loamy soils formed in loess and glacial till; on uplands and benches
- **4** — GARA-LADOGA ASSOCIATION: Gently sloping to steep, moderately well drained, loamy and silty soils formed in glacial till and loess; on uplands
- **5** — NODAWAY-COLO-ZOOK ASSOCIATION: Nearly level, moderately well drained and poorly drained, silty and clayey soils formed in alluvium; on bottom land

*Texture terms in the descriptive headings refer to the surface layer of the major soils in the associations.

COMPILED 1988

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
IOWA AGRICULTURE AND HOME ECONOMICS EXPERIMENT STATION
COOPERATIVE EXTENSION SERVICE, IOWA STATE UNIVERSITY
DIVISION OF SOIL CONSERVATION
IOWA DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP

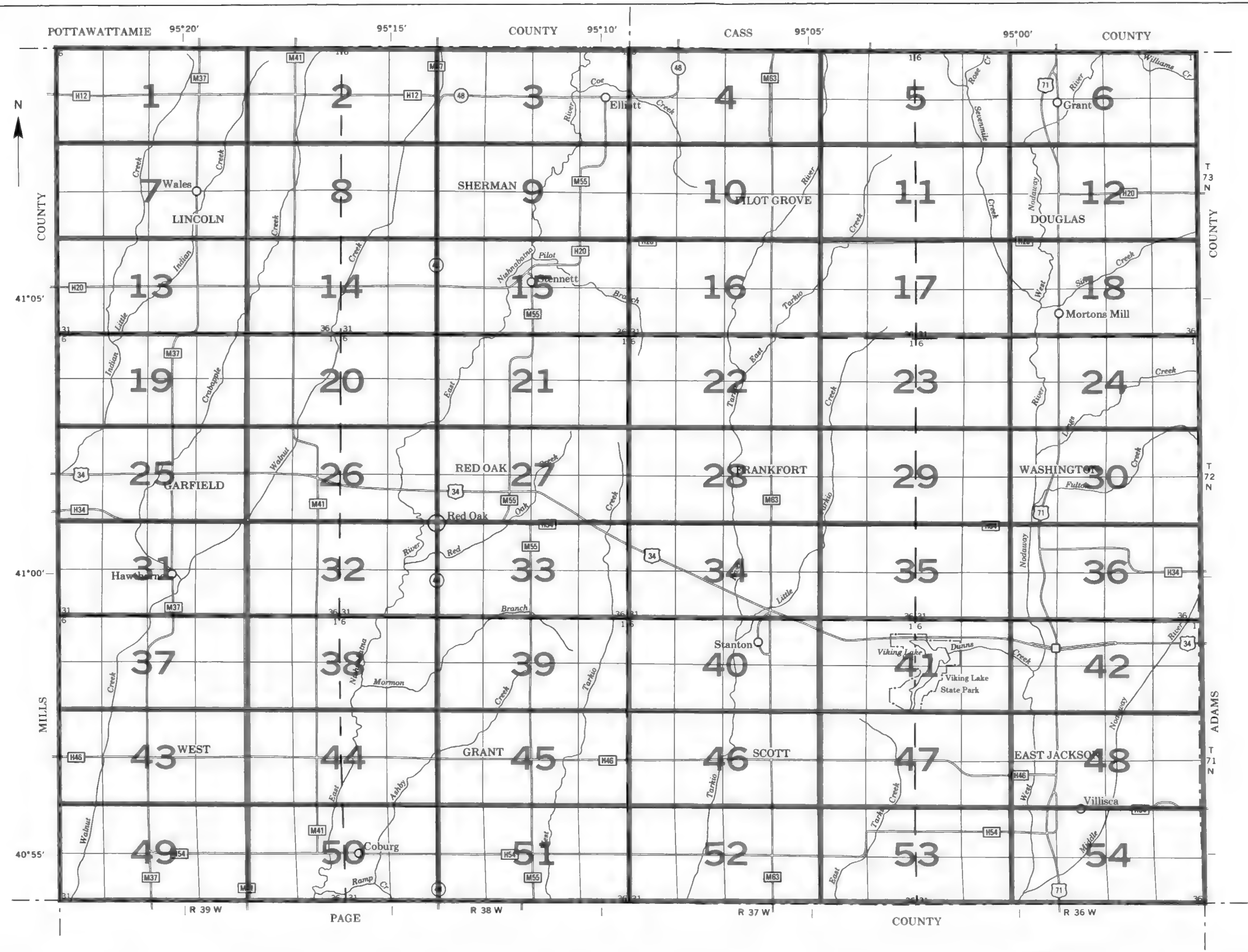
GENERAL SOIL MAP

MONTGOMERY COUNTY, IOWA

Scale 1:126,720

1 0 1 2 3 4 Mi

1 0 3 6 Km



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

MONTGOMERY COUNTY, IOWA

Scale 1:126,720

1 0 1 2 3 4 Mi

1 0 3 6 Km

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil or miscellaneous area. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is moderately eroded and 3 that it is severely eroded.

SYMBOL	NAME
8B	Judson silty clay loam, 2 to 5 percent slopes
8C	Judson silty clay loam, 5 to 9 percent slopes
9	Marshall silty clay loam, 0 to 2 percent slopes
9B	Marshall silty clay loam, 2 to 5 percent slopes
9C	Marshall silty clay loam, 5 to 9 percent slopes
9C2	Marshall silty clay loam, 5 to 9 percent slopes, moderately eroded
9D	Marshall silty clay loam, 9 to 14 percent slopes
9D2	Marshall silty clay loam, 9 to 14 percent slopes, moderately eroded
11B	Ackmore-Colo-Judson complex, 2 to 5 percent slopes
24D	Shelby loam, 9 to 14 percent slopes
24D2	Shelby loam, 9 to 14 percent slopes, moderately eroded
24E	Shelby loam, 14 to 18 percent slopes
24E2	Shelby loam, 14 to 18 percent slopes, moderately eroded
24F	Shelby loam, 18 to 25 percent slopes
33D2	Steinauer clay loam, 9 to 14 percent slopes, moderately eroded
33E2	Steinauer clay loam, 14 to 18 percent slopes, moderately eroded
43	Bremer silty clay loam, 0 to 2 percent slopes
54	Zook silty clay loam, 0 to 2 percent slopes
54+	Zook silt loam, overwash, 0 to 2 percent slopes
60D2	Malvern silty clay loam, 9 to 14 percent slopes, moderately eroded
76B	Ladoga silt loam, 2 to 5 percent slopes
76C	Ladoga silt loam, 5 to 9 percent slopes
76C2	Ladoga silt loam, 5 to 9 percent slopes, moderately eroded
76D	Ladoga silt loam, 9 to 14 percent slopes
76D2	Ladoga silt loam, 9 to 14 percent slopes, moderately eroded
88	Nevin silty clay loam, 0 to 2 percent slopes
93D2	Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded
99C2	Exira silty clay loam, 5 to 9 percent slopes, moderately eroded
99D2	Exira silty clay loam, 9 to 14 percent slopes, moderately eroded
99D3	Exira silty clay loam, 9 to 14 percent slopes, severely eroded
99E2	Exira silty clay loam, 14 to 18 percent slopes, moderately eroded
133	Colo silty clay loam, 0 to 2 percent slopes
133+	Colo silt loam, overwash, 0 to 2 percent slopes
134	Zook silty clay, 0 to 2 percent slopes
175D	Dickinson fine sandy loam, 9 to 14 percent slopes
179D	Gara loam, 9 to 14 percent slopes
179D2	Gara loam, 9 to 14 percent slopes, moderately eroded
179E	Gara loam, 14 to 18 percent slopes
179E2	Gara loam, 14 to 18 percent slopes, moderately eroded
179F	Gara loam, 18 to 25 percent slopes
192D2	Adair clay loam, 9 to 14 percent slopes, moderately eroded
212	Kennebec silt loam, 0 to 2 percent slopes
212+	Kennebec silt loam, overwash, 0 to 2 percent slopes
220	Nodaway silt loam, 0 to 2 percent slopes
222C2	Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded
222D2	Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded
269	Humeston silt loam, 0 to 2 percent slopes
273B	Olmitz loam, 2 to 5 percent slopes
273C	Olmitz loam, 5 to 9 percent slopes
318F2	Clanton silty clay loam, 12 to 20 percent slopes, moderately eroded
370B	Sharpsburg silty clay loam, 2 to 5 percent slopes
370C	Sharpsburg silty clay loam, 5 to 9 percent slopes
370C2	Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded
370D	Sharpsburg silty clay loam, 9 to 14 percent slopes
370D2	Sharpsburg silty clay loam, 9 to 14 percent slopes, moderately eroded
423D2	Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded
430	Ackmore silt loam, 0 to 2 percent slopes
509	Marshall silty clay loam, benches, 0 to 2 percent slopes
509B	Marshall silty clay loam, benches, 2 to 5 percent slopes
509C2	Marshall silty clay loam, benches, 5 to 9 percent slopes, moderately eroded
517D2	Hesch Variant loam, 9 to 14 percent slopes, moderately eroded
517E	Hesch Variant loam, 14 to 20 percent slopes
692D2	Mayberry silty clay loam, 5 to 14 percent slopes, moderately eroded
751D2	Northboro silty clay loam, 5 to 14 percent slopes, moderately eroded
822D2	Lamoni clay loam, 9 to 14 percent slopes, moderately eroded
870	Sharpsburg silty clay loam, benches, 0 to 2 percent slopes
870B	Sharpsburg silty clay loam, benches, 2 to 5 percent slopes
870C2	Sharpsburg silty clay loam, benches, 5 to 9 percent slopes, moderately eroded
1220	Nodaway silt loam, channeled, 0 to 2 percent slopes
1233	Corley silt loam, benches, 0 to 2 percent slopes
1299	Minden silty clay loam, benches, 0 to 2 percent slopes
1368	Macksburg silty clay loam, benches, 0 to 2 percent slopes
5010	Pits, sand and gravel
5030	Pits, limestone quarries
5040	Orthents, loamy

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- County or parish
- Reservation (national forest or park, state forest or park, and large airport)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, or cemetery — Davis Airstrip

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads

ROAD EMBLEMS & DESIGNATIONS

- Federal — 416
- State — 52

RAILROAD

LEVEES

- Without road
- With road

DAMS

- Large (to scale)
- Medium or small — water, w

PITS

- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Drainage end
- Canals or ditches
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Wet spot
- Sewage lagoon — S.L.

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 9D2, 24D

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

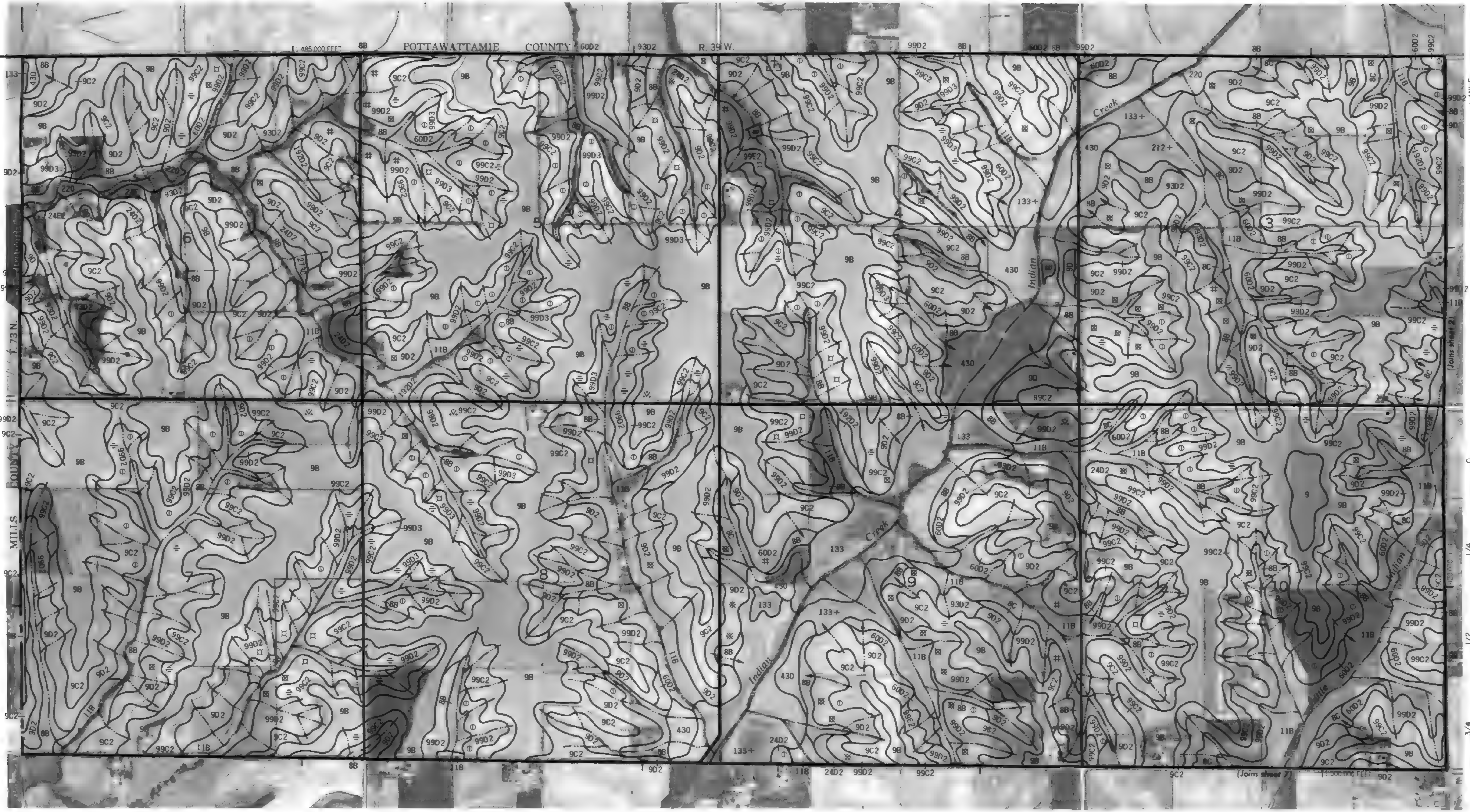
SOIL SAMPLE SITE (normally not shown) — S

MISCELLANEOUS (each symbol represents 2 acres or less)

- Clay spot (gray color at or near the surface)
- Gravelly spot
- Dumps and other similar non soil areas
- Rock outcrop
- Sandy spot
- Severely eroded spot
- Noncalcareous gray loess spot
- Red clay spot
- Calcareous spot
- Spot of Corley soils
- Spot of Mayberry soils
- Shale outcrop
- Glacial till spot
- Borrow area

1

N



1 MILE

1 KILOMETER

Scale 1:15 840

MONTGOMERY COUNTY, IOWA NO. 1

SOIL MAP OF MONTGOMERY COUNTY, IOWA — SHEET NUMBER 2

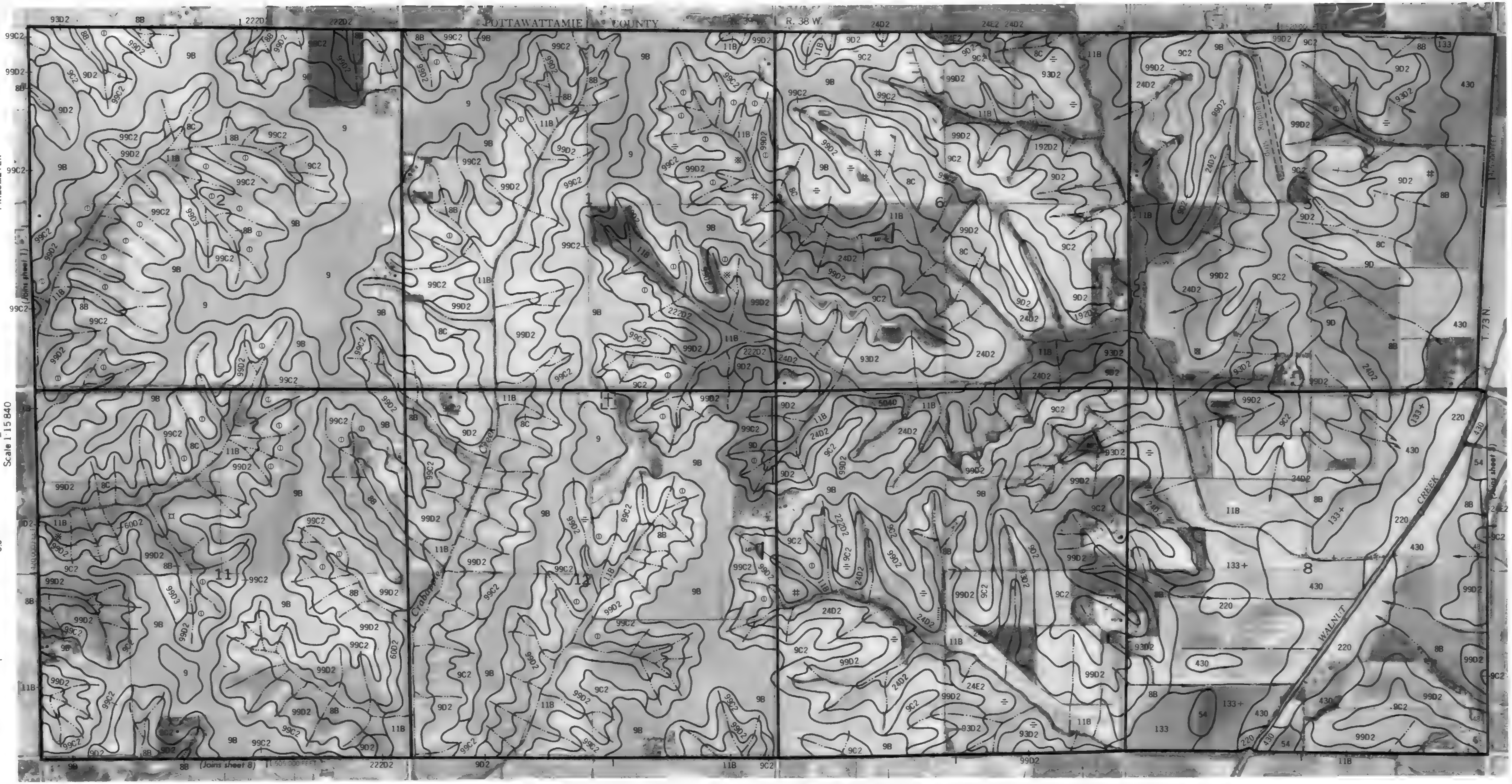
N

1 MILE

1 KILOMETER

Scale 1:15 840

0 1/4 0.5 1/2 3/4

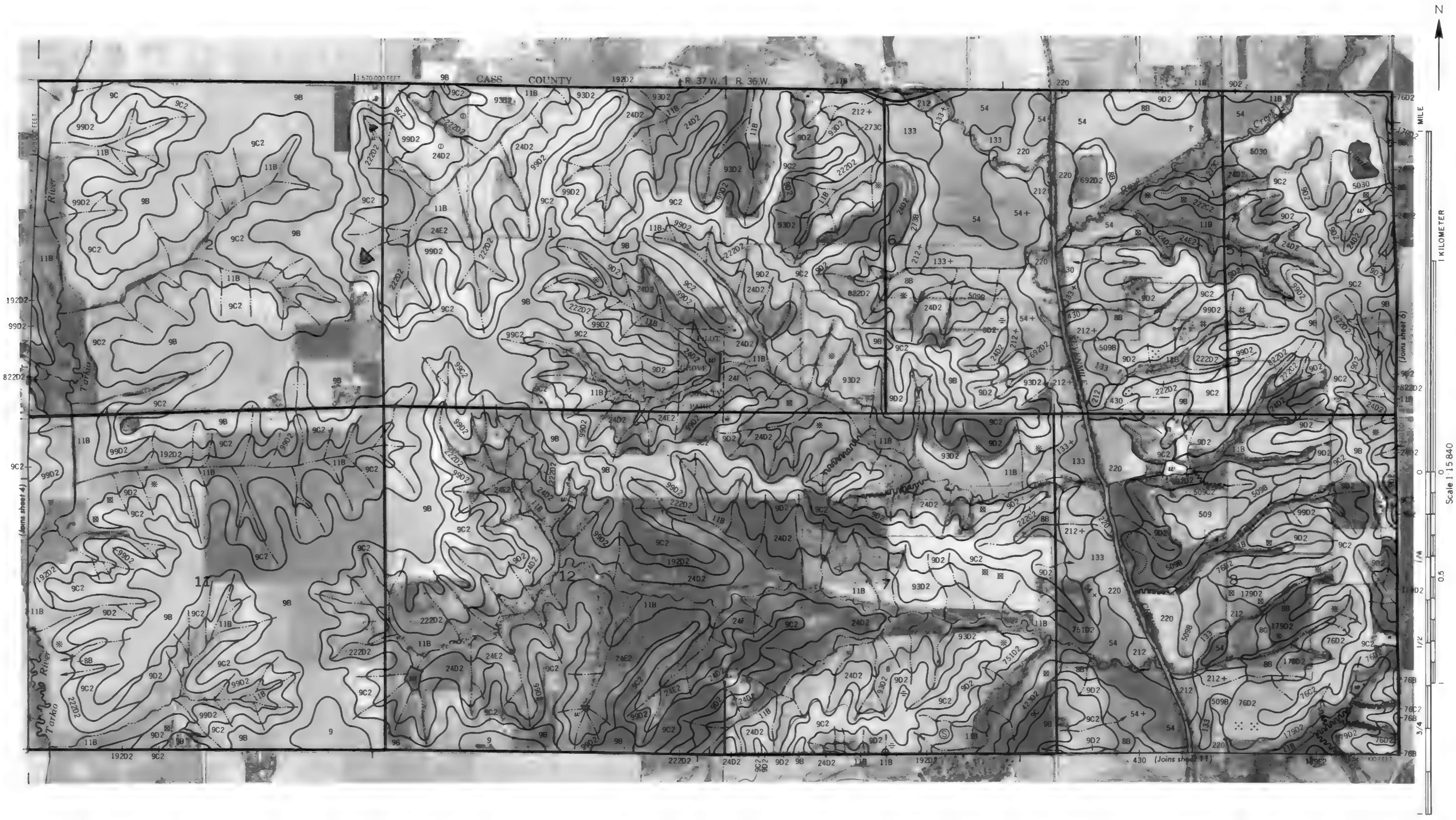


MONTGOMERY COUNTY, IOWA NO. 2

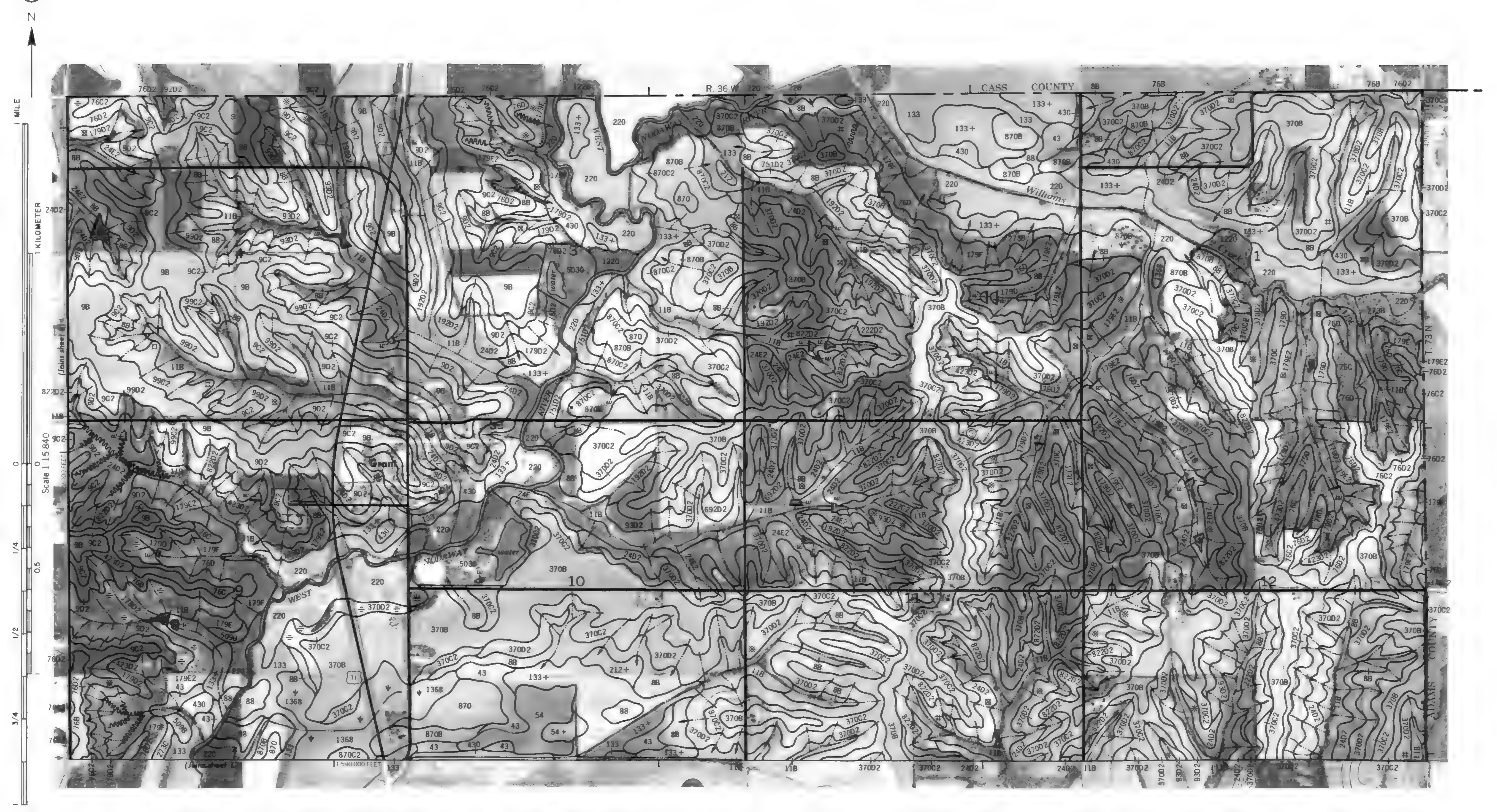
3

MONTGOMERY COUNTY, IOWA NO. 3

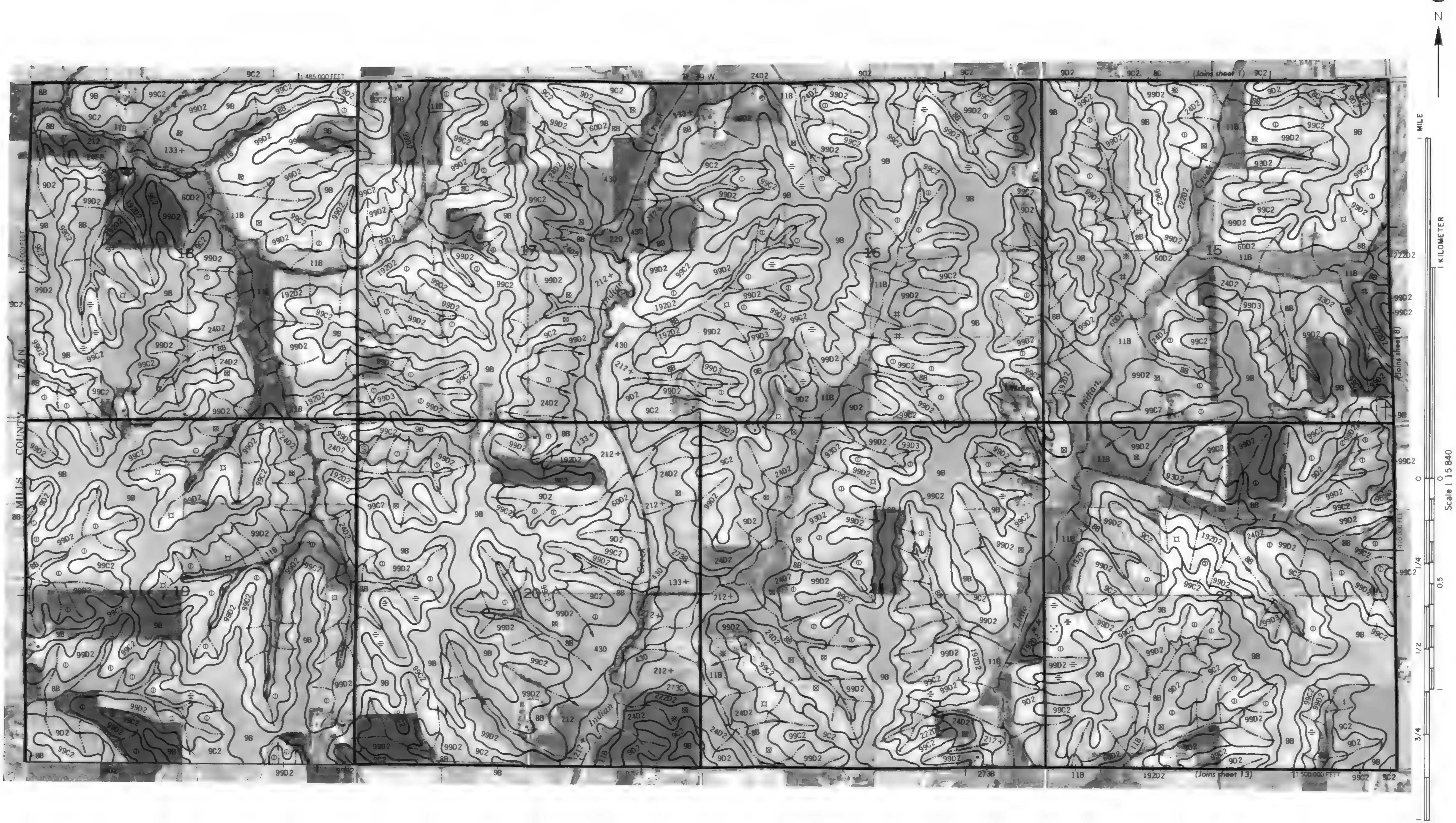

4
N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
0.5
1/2
3/4
CASS COUNTY
R. 37 W
T. 73 N.
(Joins sheet 3)
(Joins sheet 10)
(Joins sheet 5)
Creek
Tarkio
1
3
4
5
6
7
8
9
10

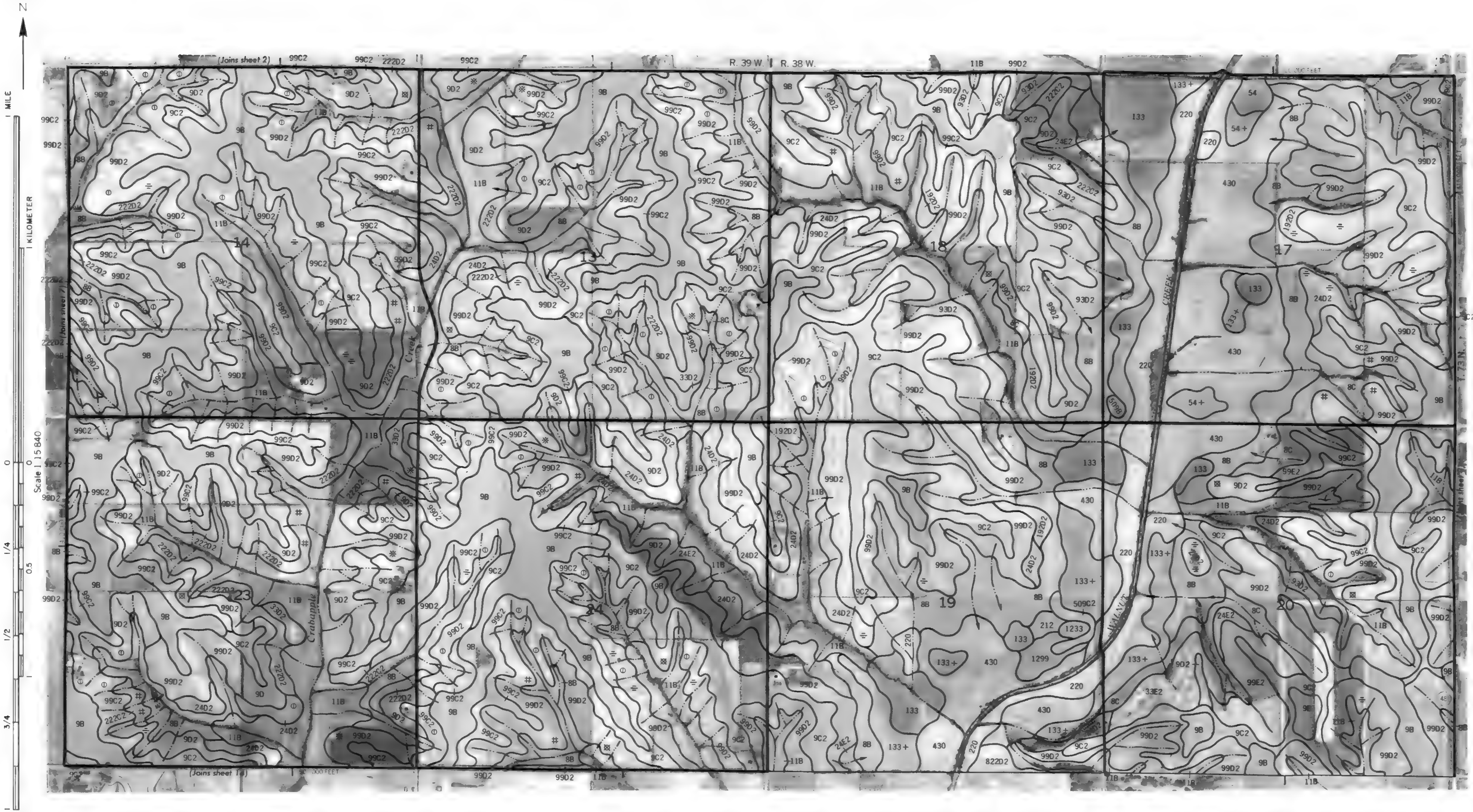


MONTGOMERY COUNTY, IOWA NO. 5



MONTGOMERY COUNTY, IOWA NO. 6

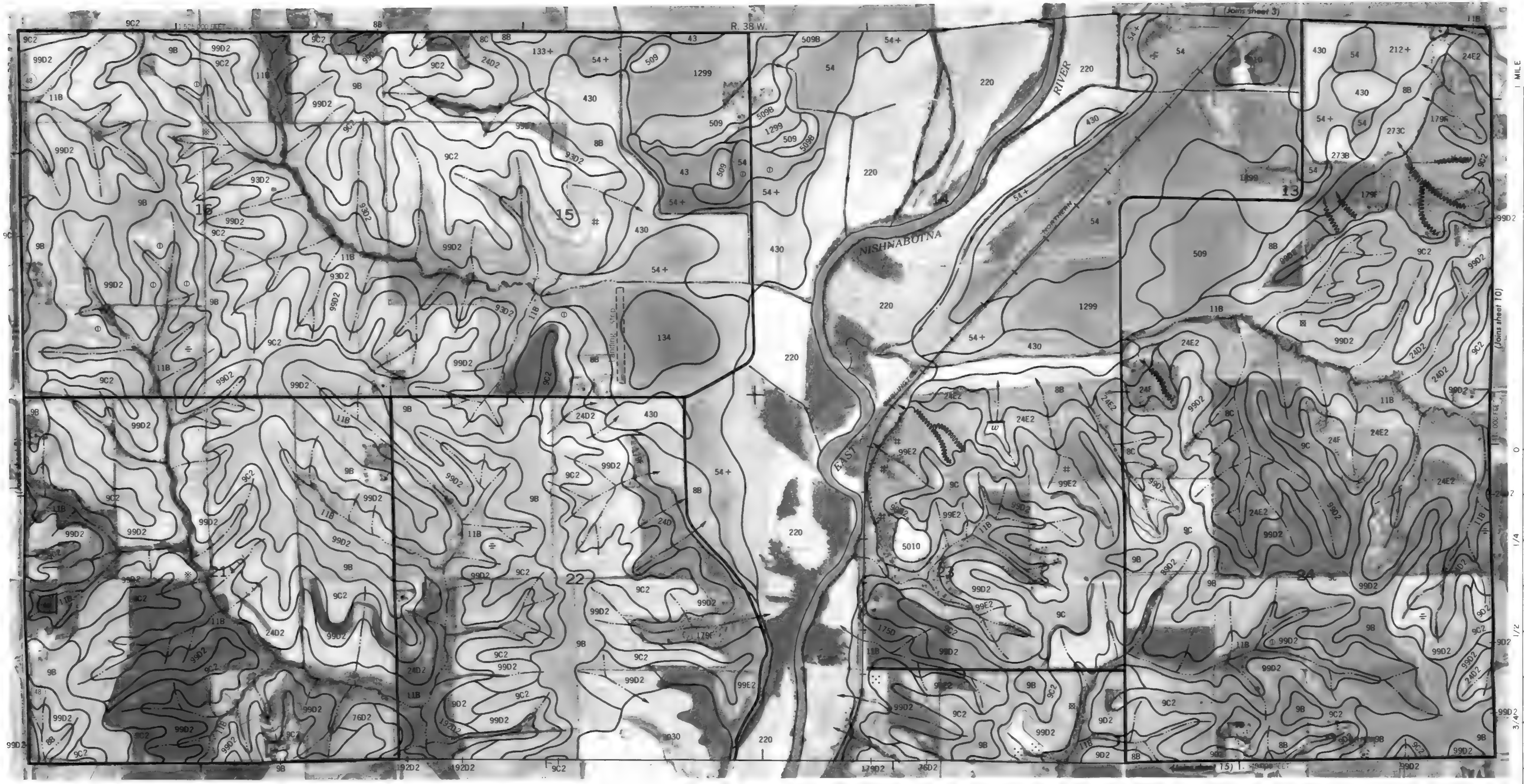

7
N
(Joins sheet 1)
(Joins sheet 8)
(Joins sheet 13)
1 485 000 FEET
1 500 000 FEET
R. 39 W.
T. 73 N.
MILLS COUNTY
Indian Creek
Little Indian
Milton Creek
15
16
17
18
19
20
21
22
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5


N
1 MILE
1 KILOMETER
Scale 1:15 840
(Joins sheet 2)
(Joins sheet 7)
(Joins sheet 14)
(Joins sheet 9)
R. 39 W.
R. 38 W.
T. 73 N.
5 000 FEET
Creek
Crabapple
WALNUT
CREEK
14
13
18
17
23
24
19
20

9

N

MONTGOMERY COUNTY, IOWA NO. 9



1 MILE

1 KILOMETER

Scale 1:15 840

0

1/4

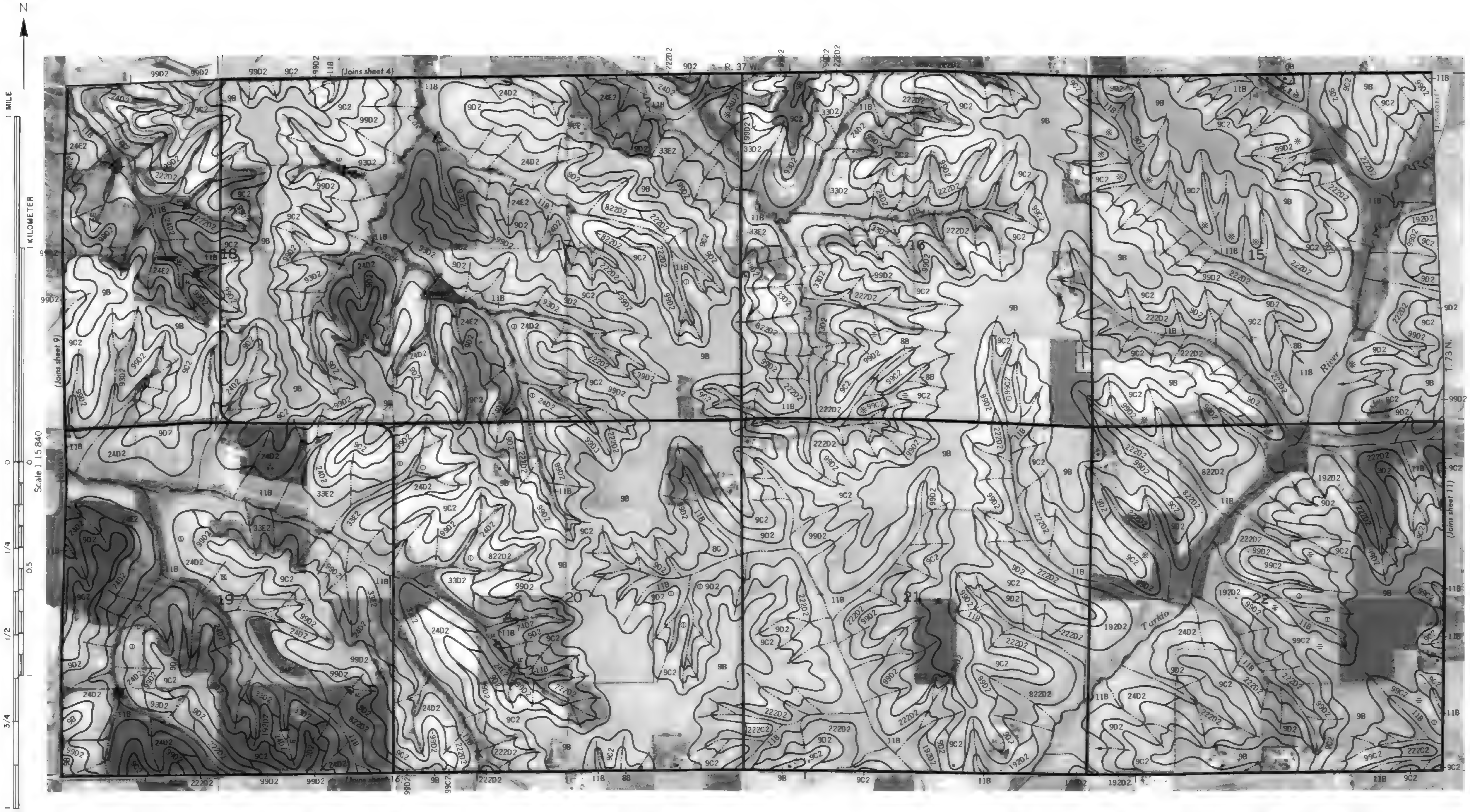
1/2

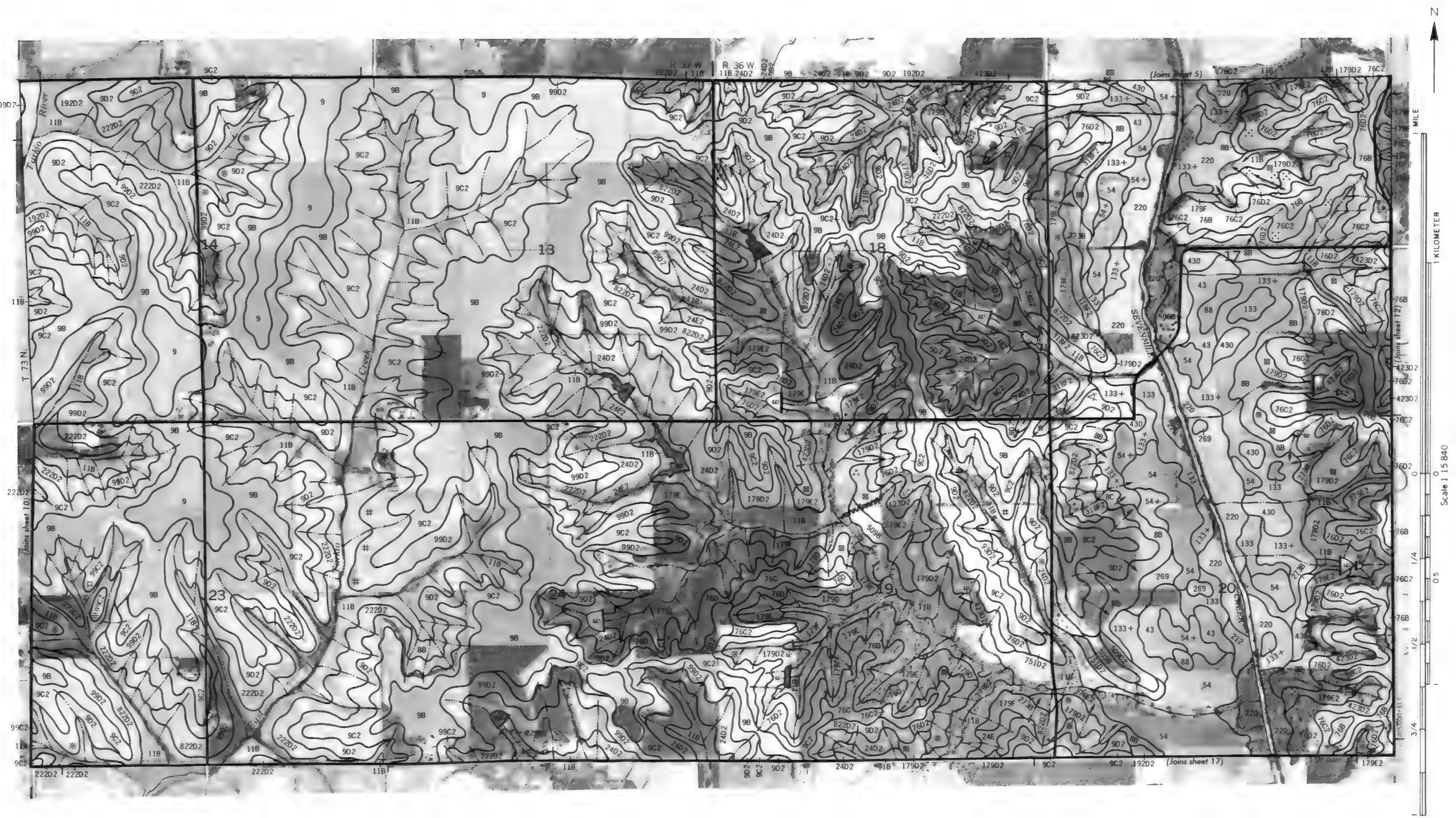
3/4

0

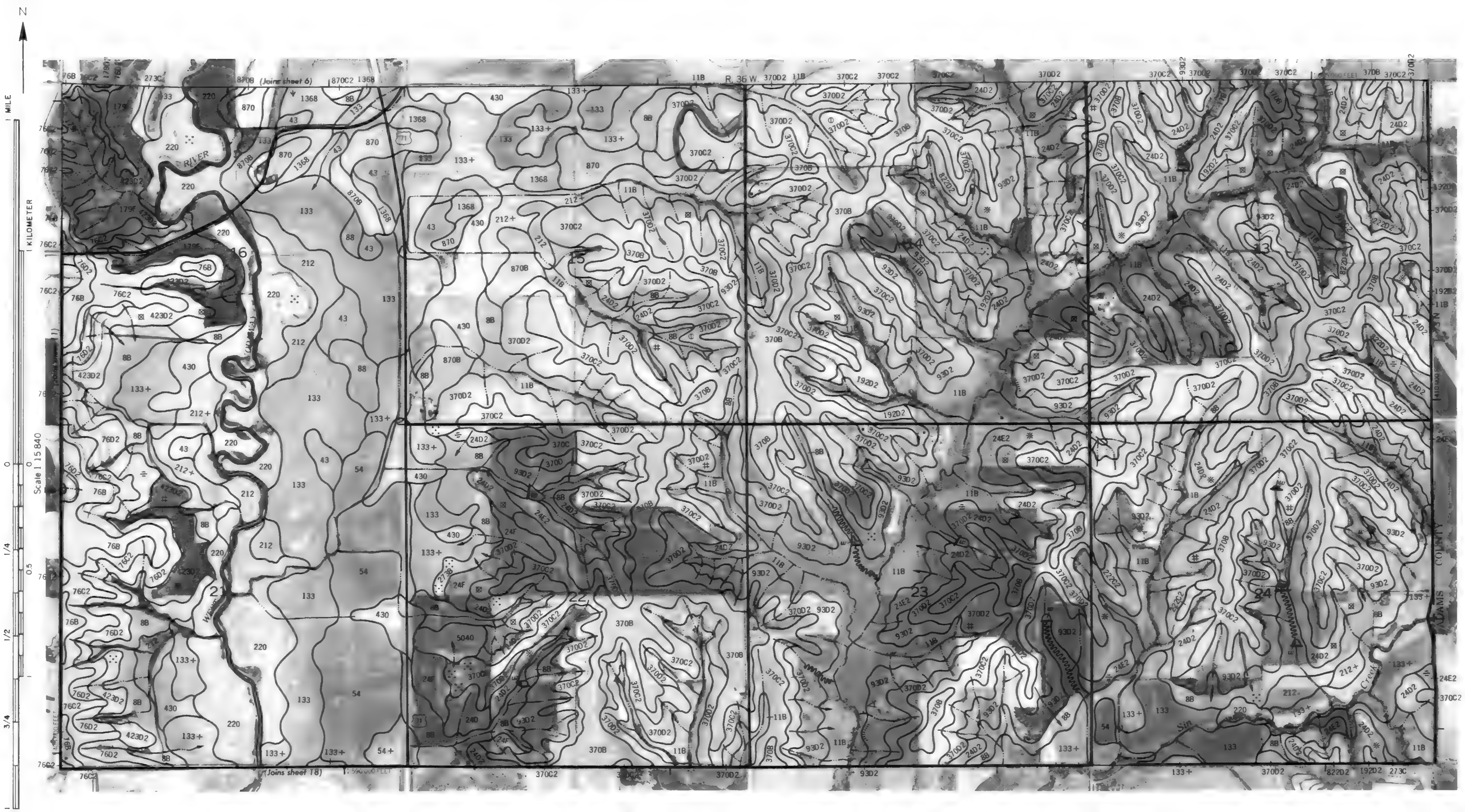
0.5

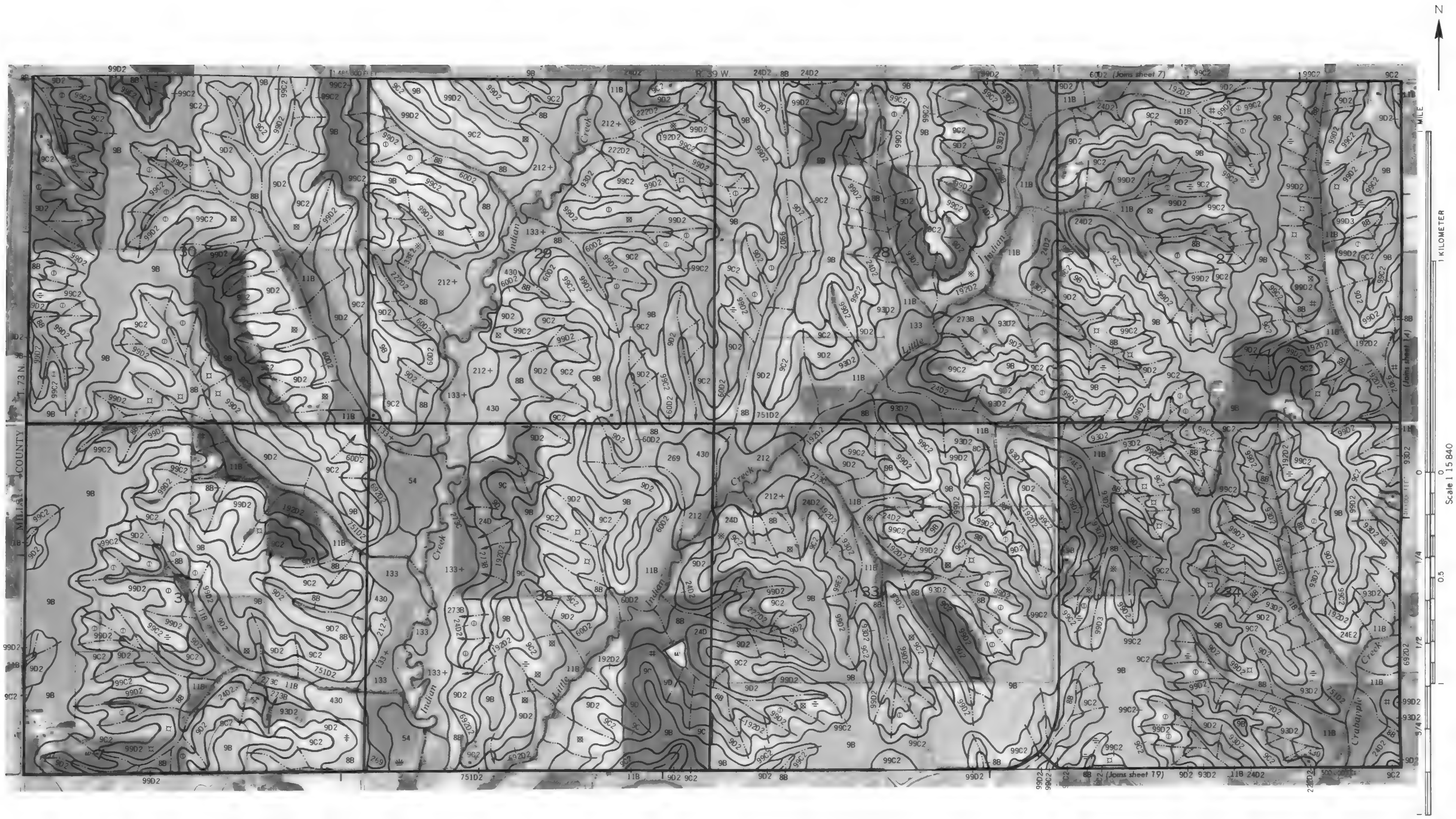
(10)

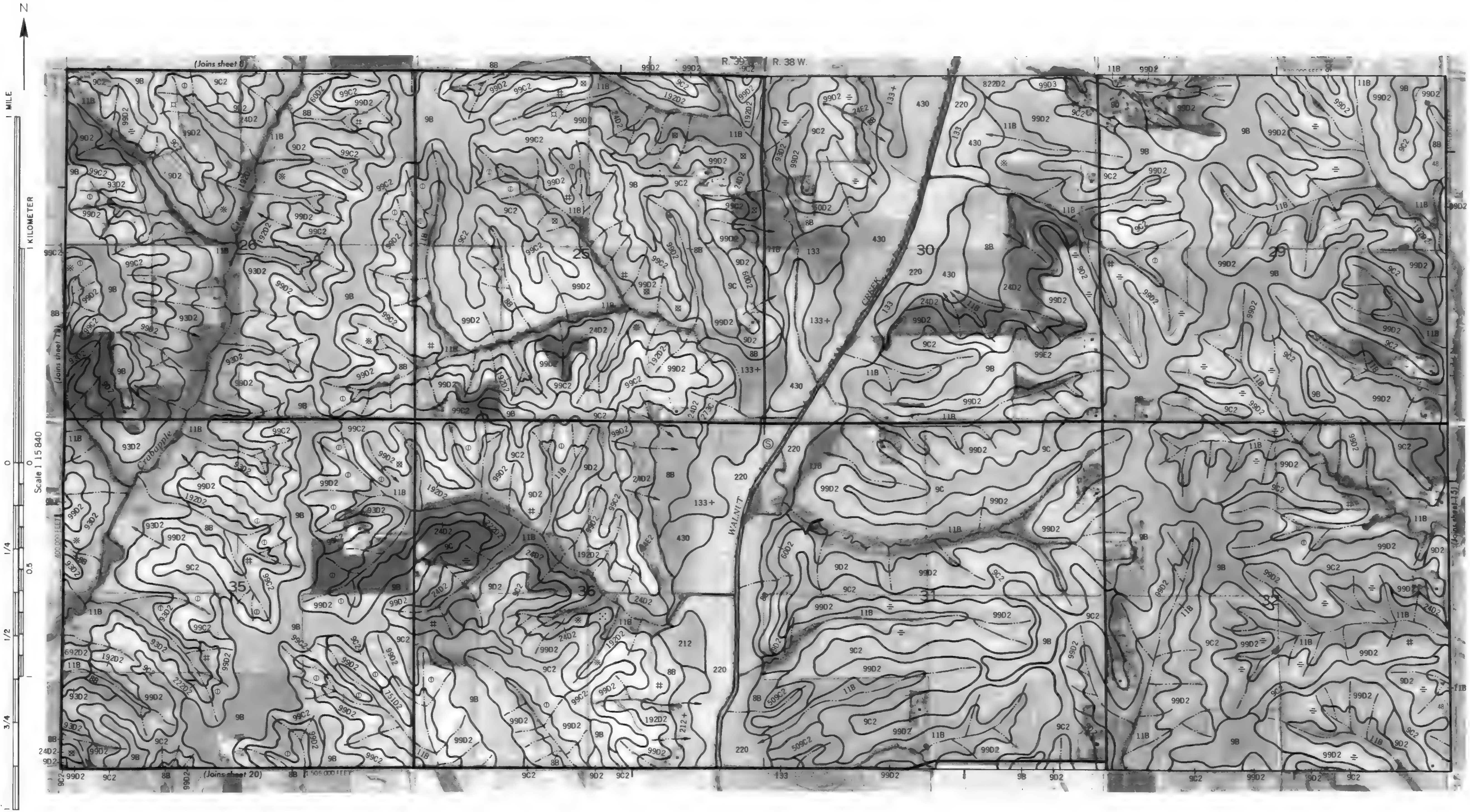

N
MILE
KILOMETER
Scale 1:15 840
(Joins sheet 4)
R. 37 W.
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 16)
T. 73 N.
Creek
River
Turkio
15
16
17
18
19
20
21
22

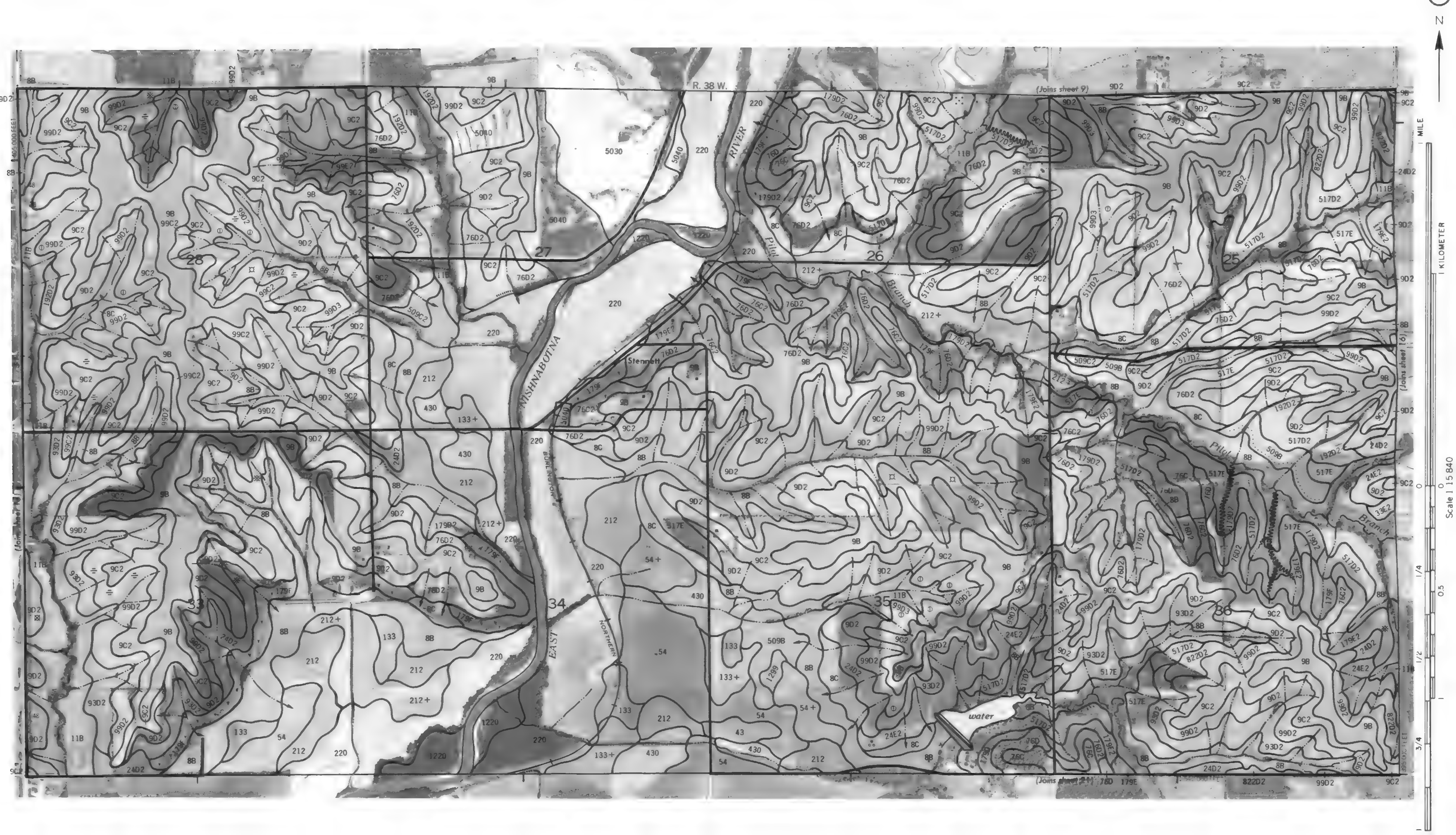


N
R. 37 W.
R. 36 W.
T. 73 N.
(Joins sheet 5)
(Joins sheet 12)
(Joins sheet 17)
(Joins sheet 10)
Tarkio River
Creek
SEVENMILE
CREEK
13
14
17
18
19
20
23
24
1 MILE
1 KILOMETER
Scale 1:15 840

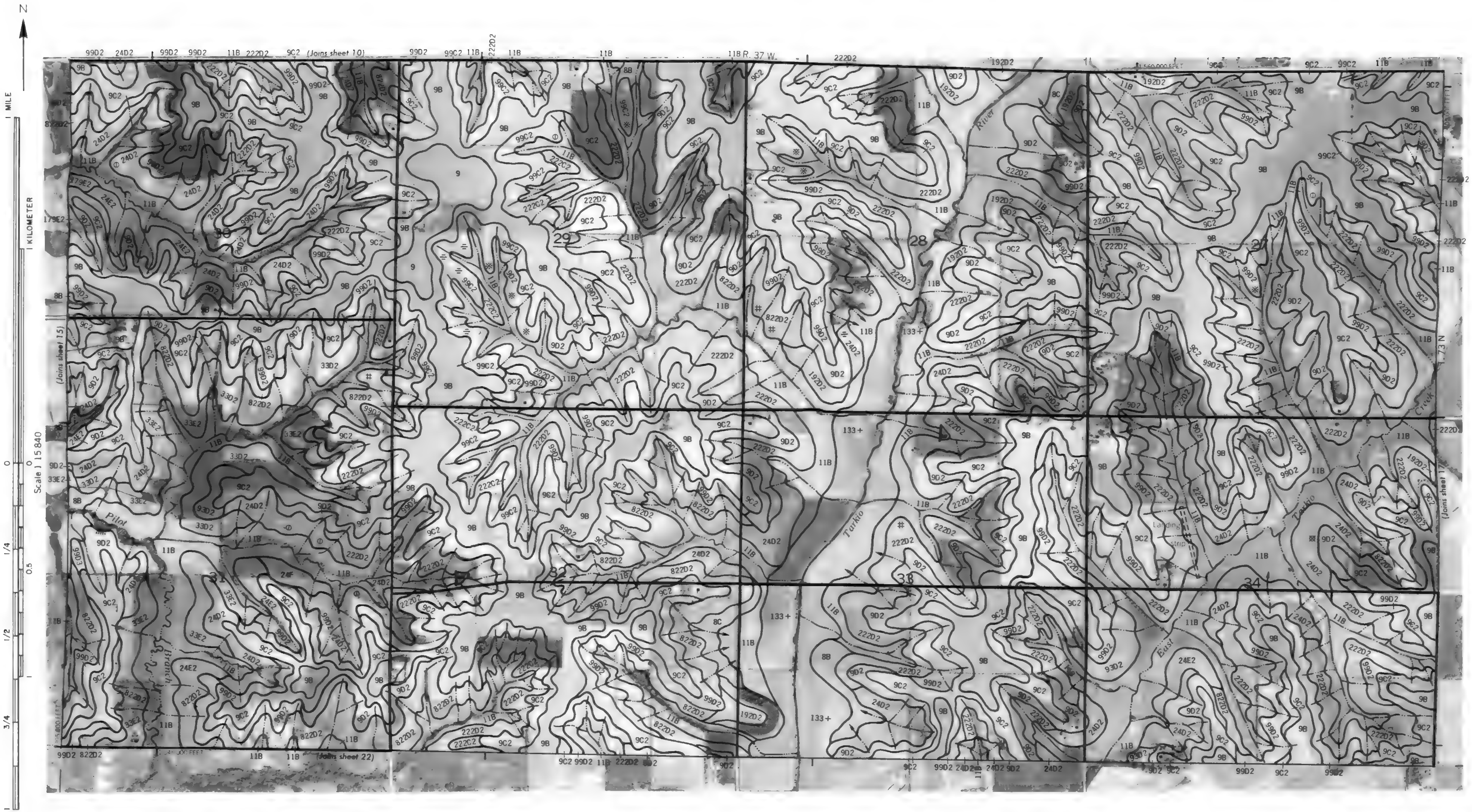

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
(Joins sheet 6)
(Joins sheet 18)
(Joins sheet 11)
R. 36 W.
RIVER
Sin Creek
ADAMS COUNTY
16
15
13
21
22
23
24

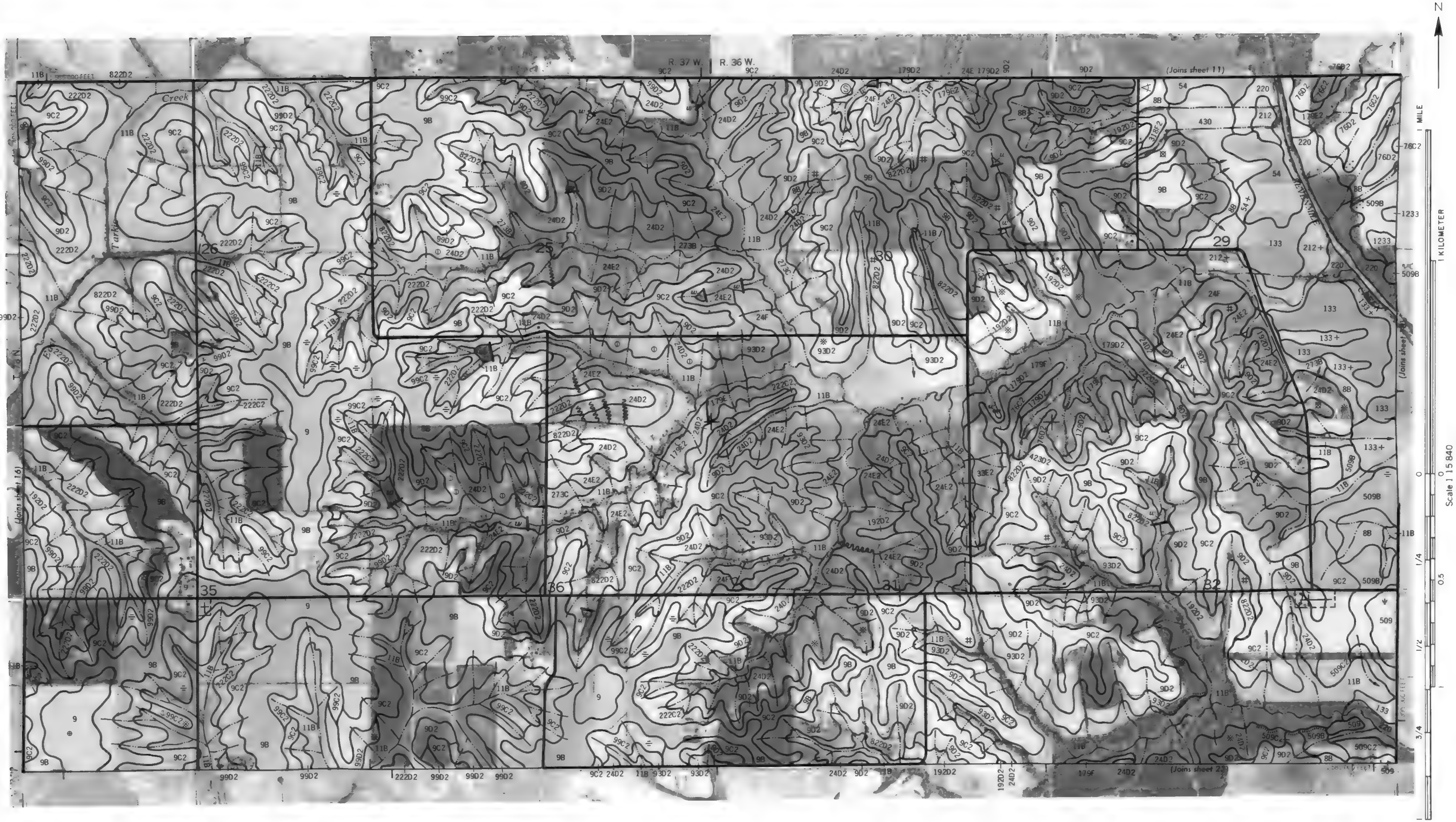

N
(Joins sheet 7)
R. 39 W.
T. 73 N.
MILLS COUNTY
(Joins sheet 14)
(Joins sheet 19)
Indian Creek
Little Indian Creek
Crabapple Creek
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
30
29
28
27
31
32
33
34


N
1 MILE
1 KILOMETER
Scale 1:15 840
(Joins sheet 8)
(Joins sheet 20)
(Joins sheet 13)
(Joins sheet 15)
R. 39 W.
R. 38 W.
Crabapple
WALNUT
CREEK
26
25
30
29
35
36
31
32


15
N
R. 38 W.
(Joins sheet 9)
(Joins sheet 16)
(Joins sheet 21)
NISHNABOTNA
RIVER
EAST
Pilot
Branch
Stennett
BURLINGTON
NORTHERN
water
25
26
27
28
33
34
35
36
1 MILE
1 KILOMETER
Scale 1:15 840

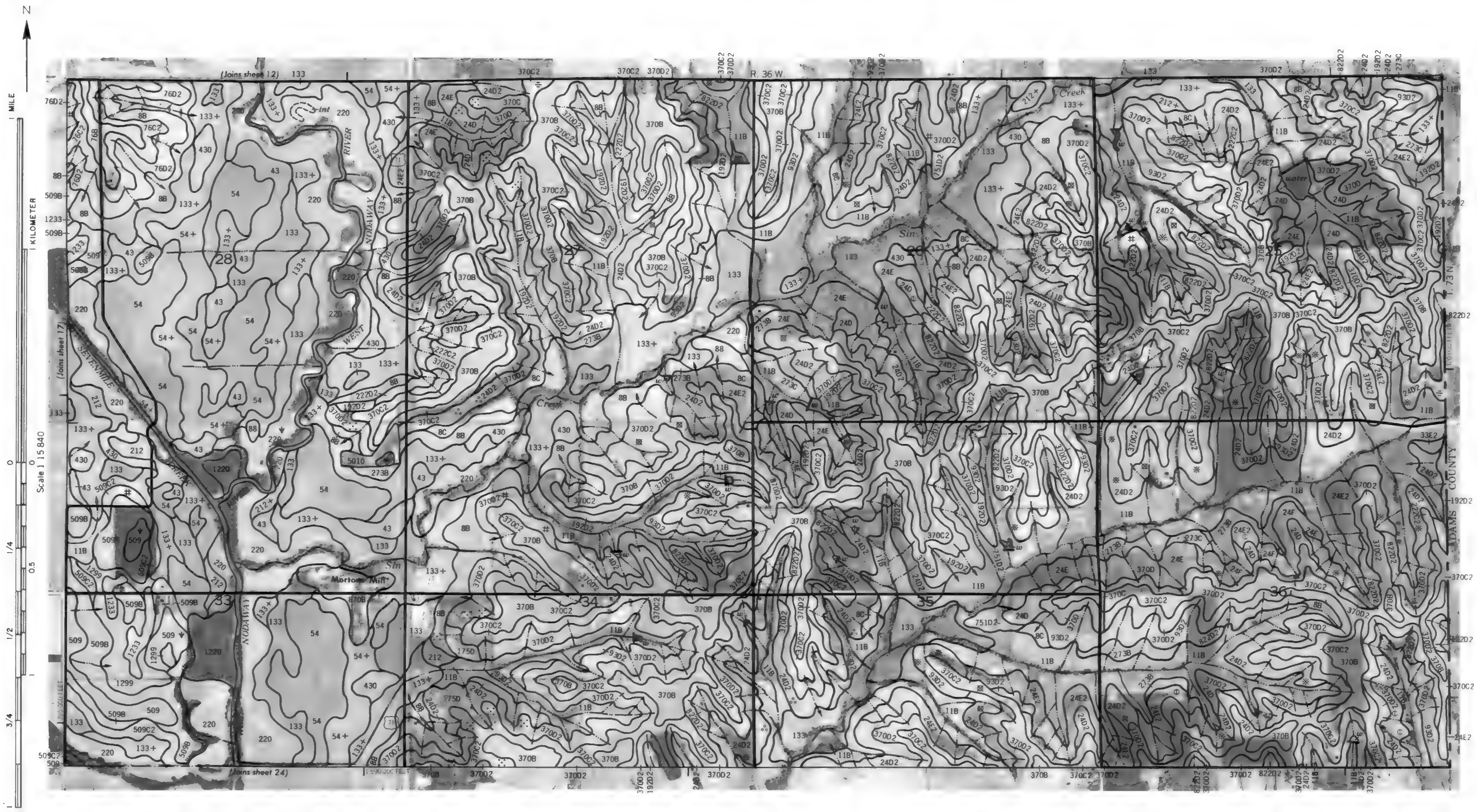
SOIL MAP OF MONTGOMERY COUNTY, IOWA — SHEET NUMBER 16



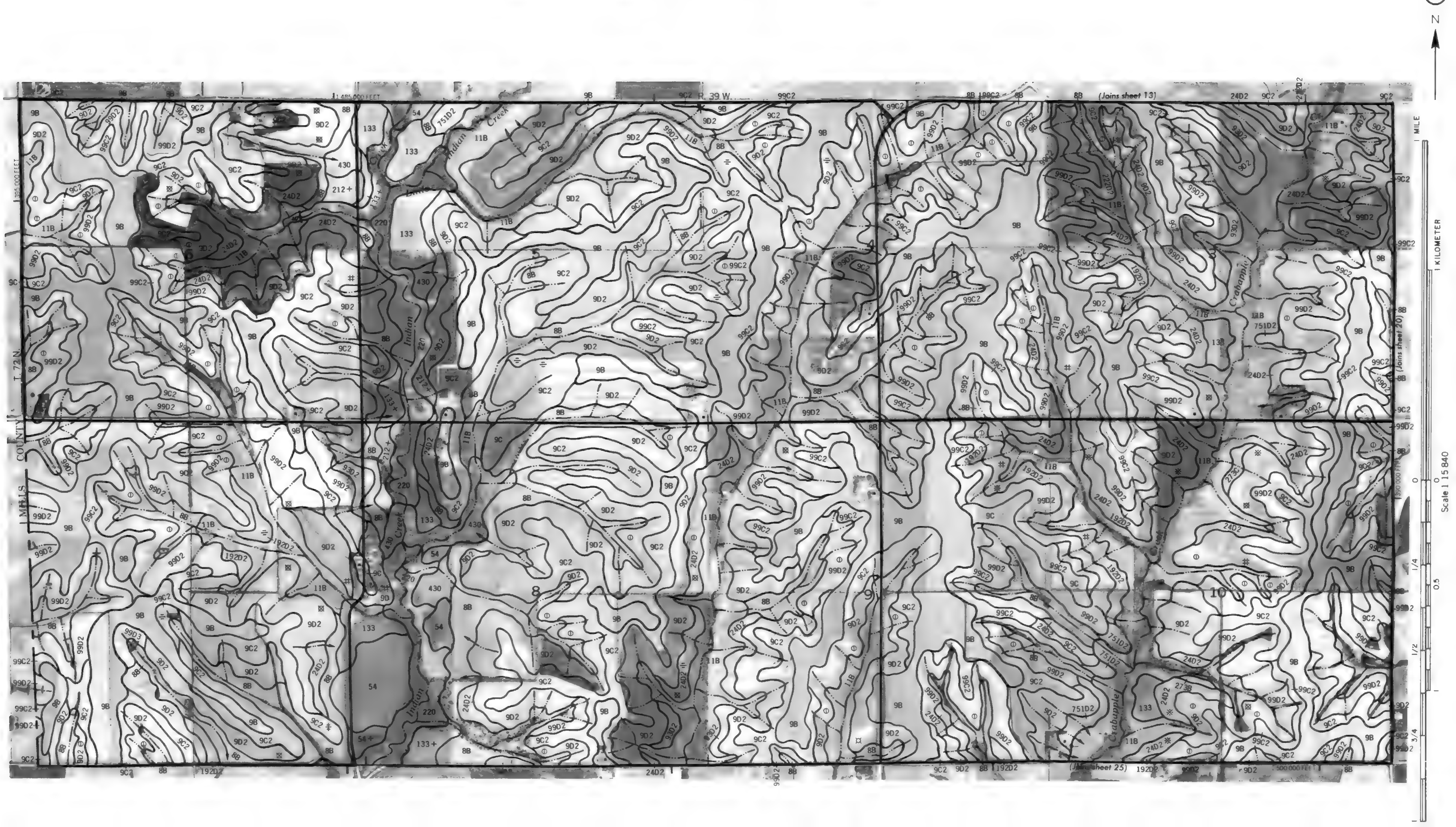


MONTGOMERY COUNTY, IOWA NO. 17

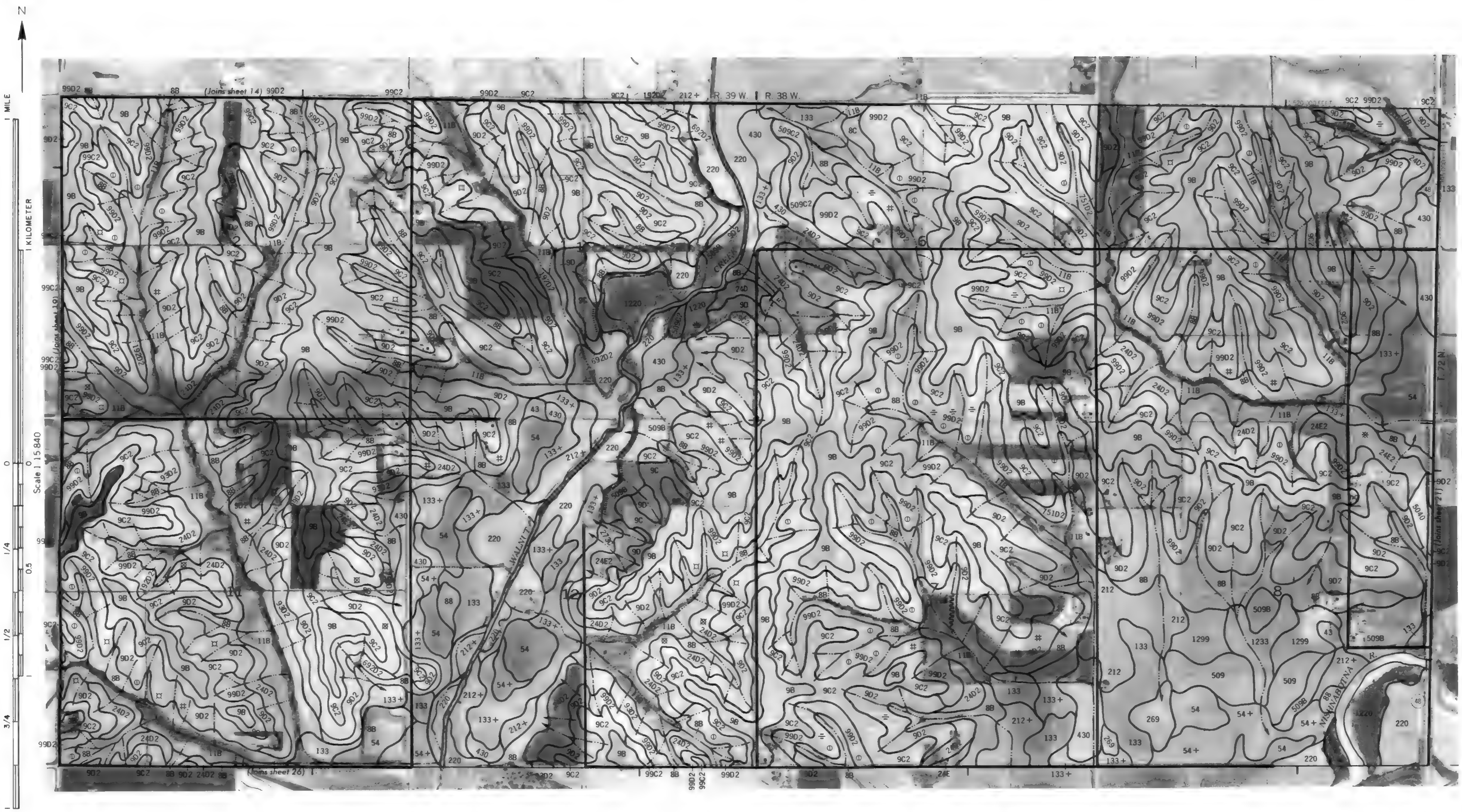
SOIL MAP OF MONTGOMERY COUNTY, IOWA — SHEET NUMBER 18



MONTGOMERY COUNTY, IOWA NO. 19

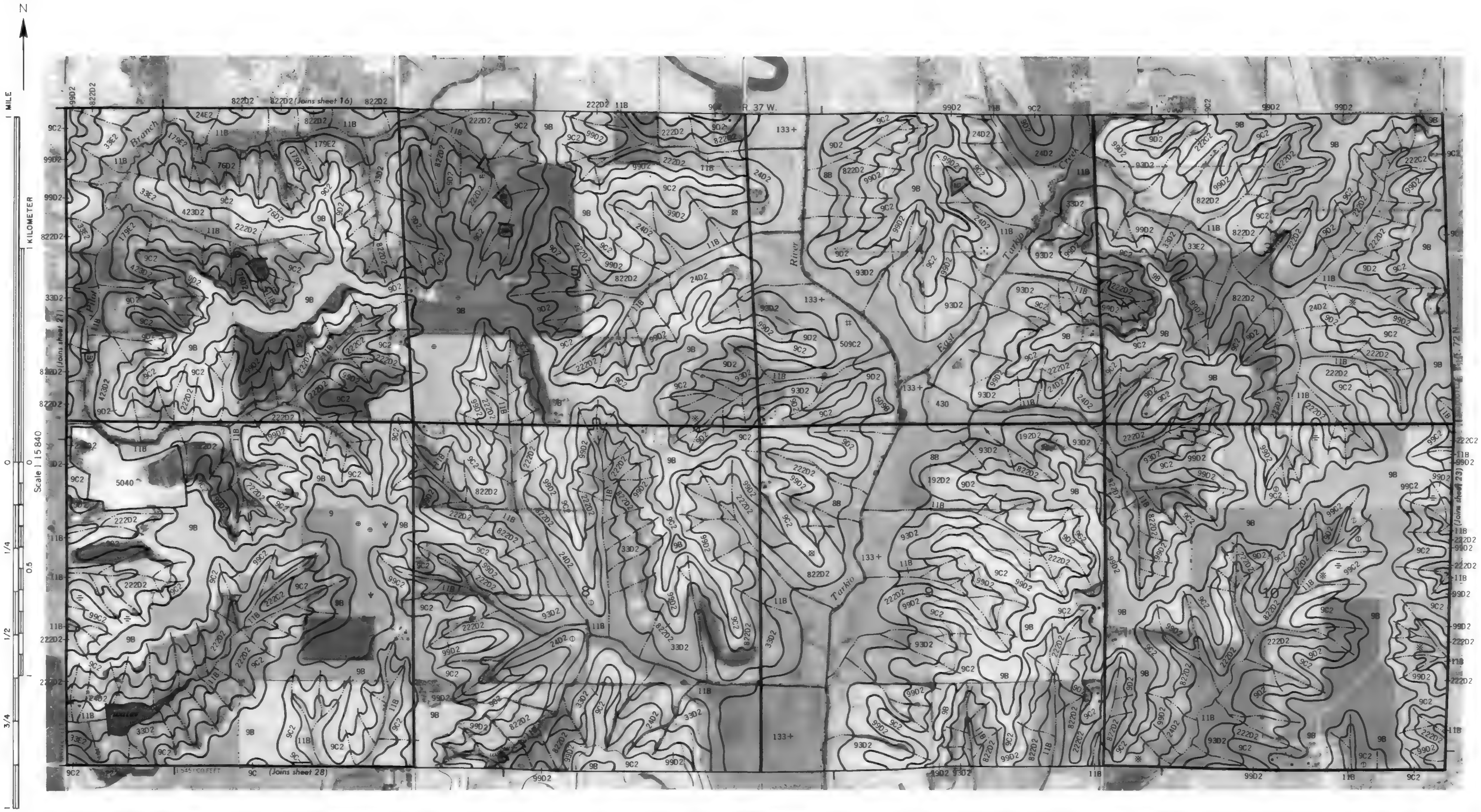


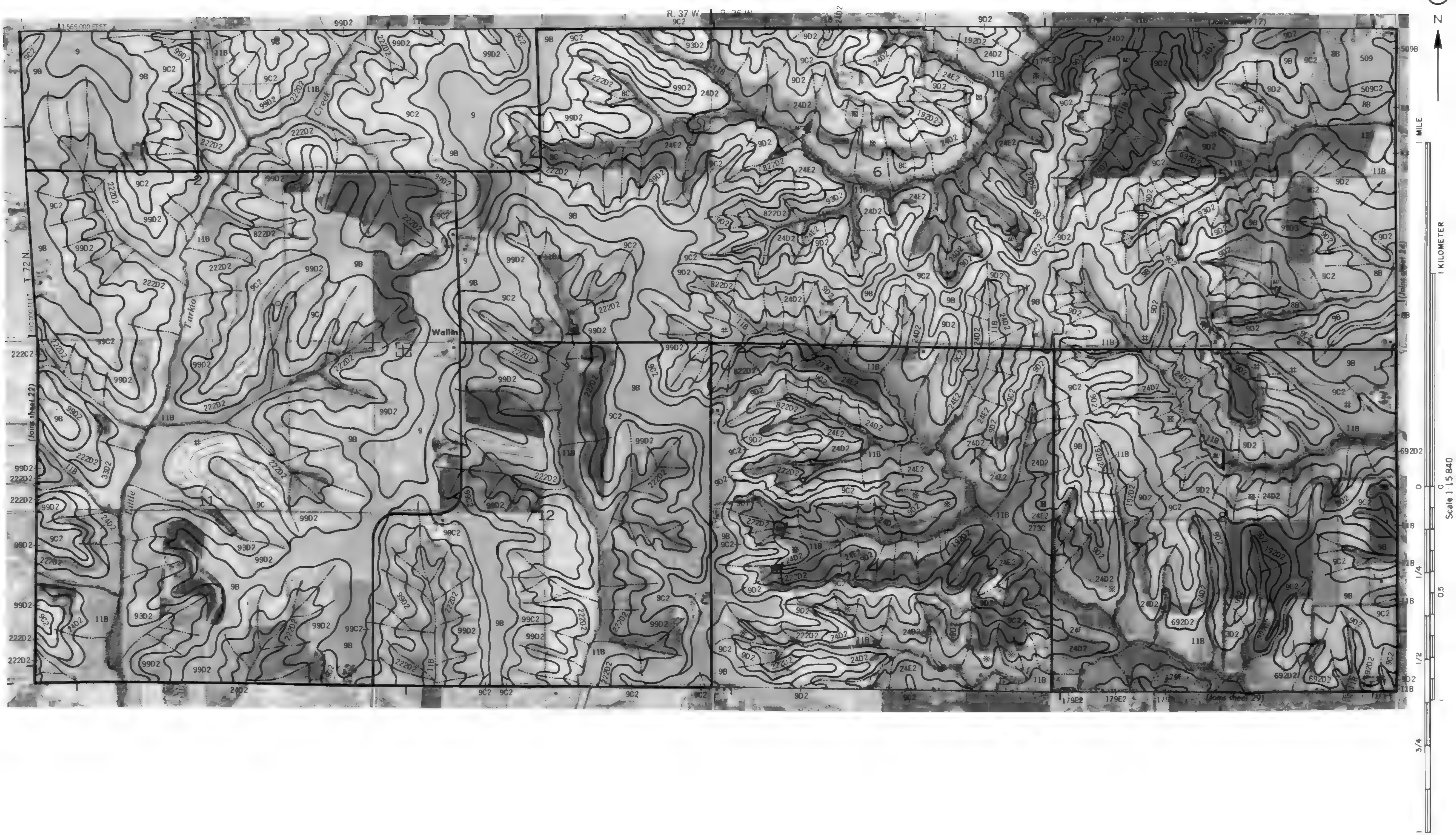
SOIL MAP OF MONTGOMERY COUNTY, IOWA — SHEET NUMBER 20



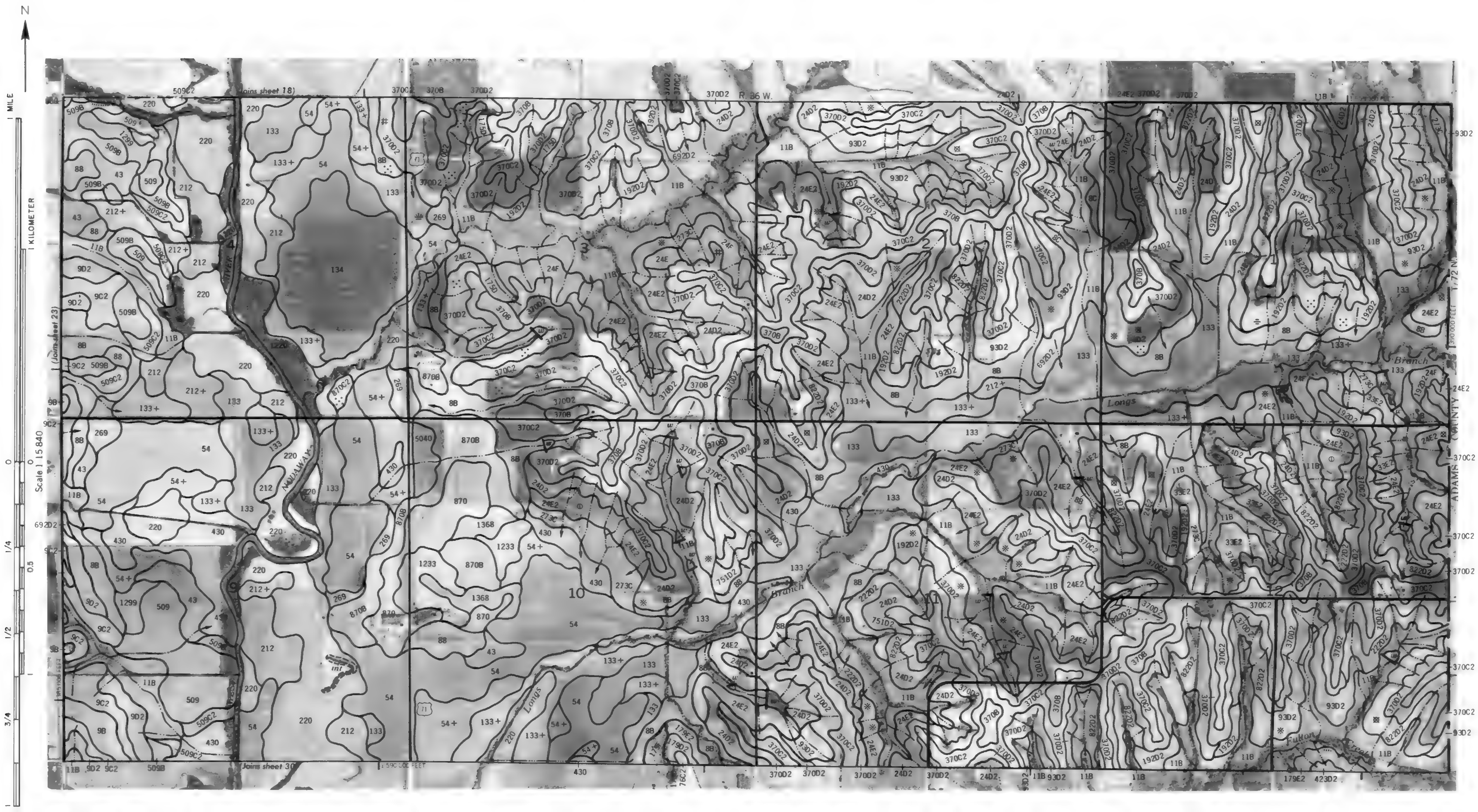

N
R. 38 W
T. 72 N
(Joins sheet 15)
(Joins sheet 22)
(Joins sheet 27)
(Joins sheet 20)
NISHNABOTNA
EAST
water
water
water
MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
1
2
3
4
9
10
11
12

22

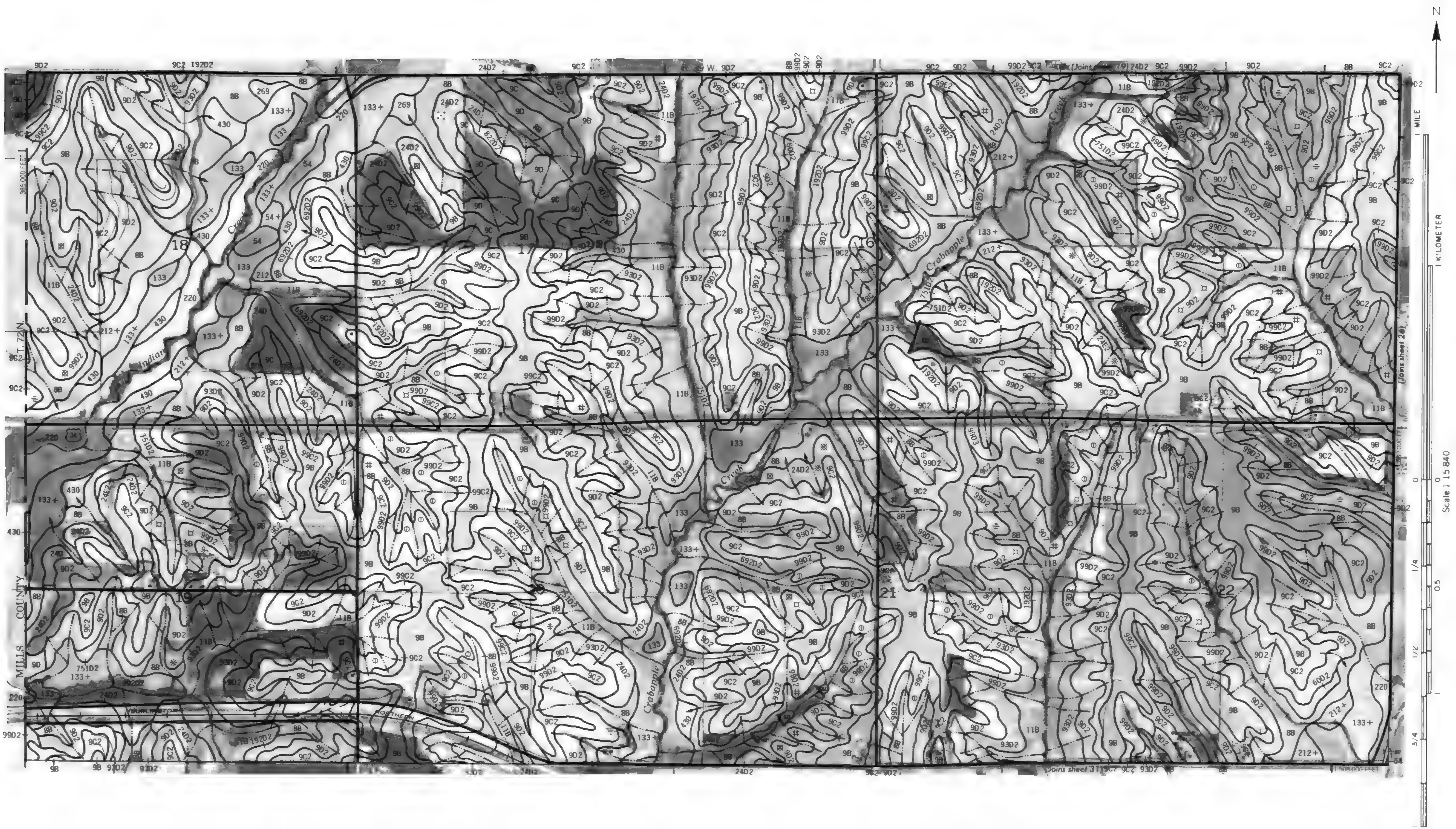

N
1 MILE
1 KILOMETER
Scale 1:15 840
(Joins sheet 16)
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 28)
R. 37 W.
T. 72 N.
Branch
River
East
Tarkio
Creek
5
8
9
10

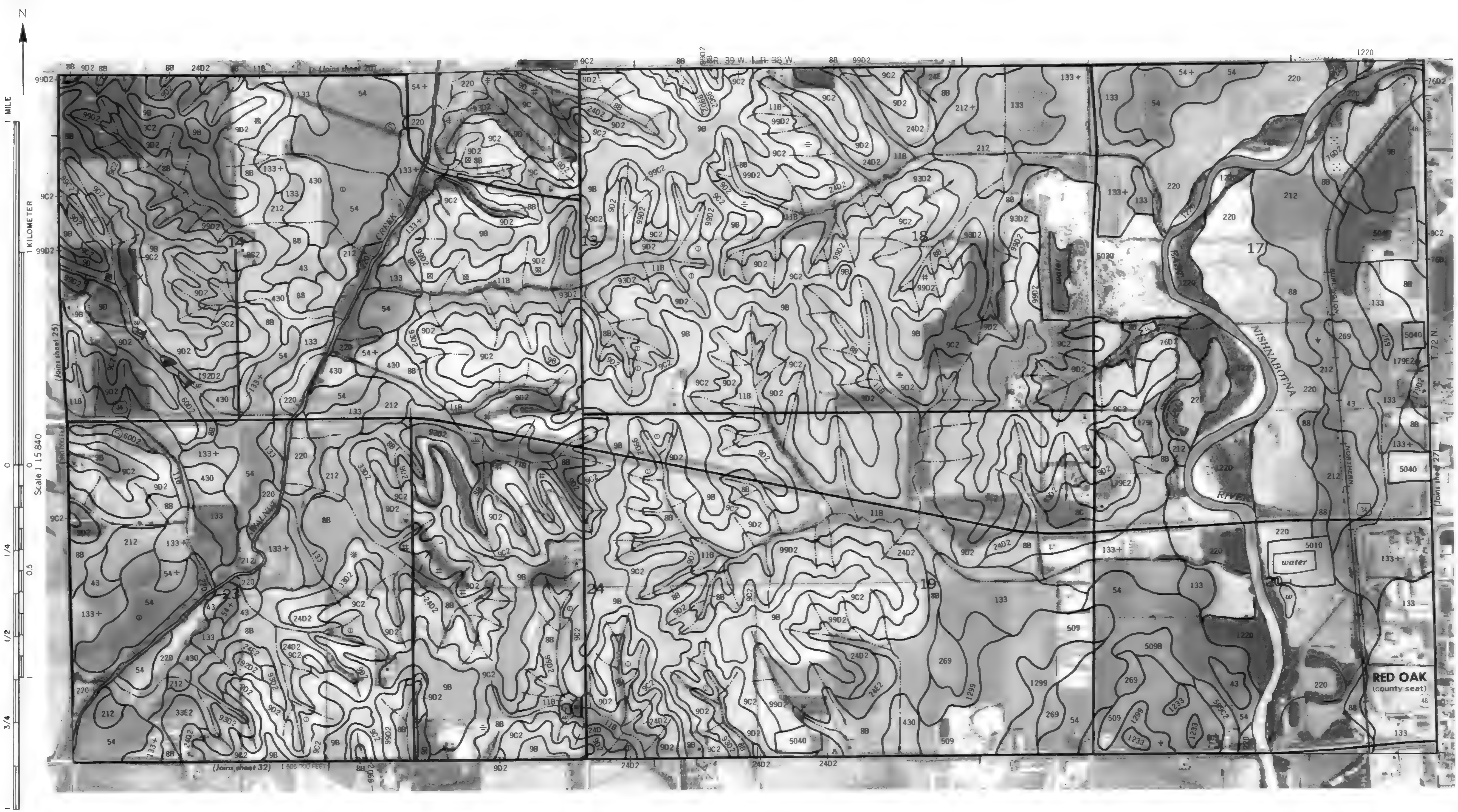


MONTGOMERY COUNTY, IOWA NO. 23

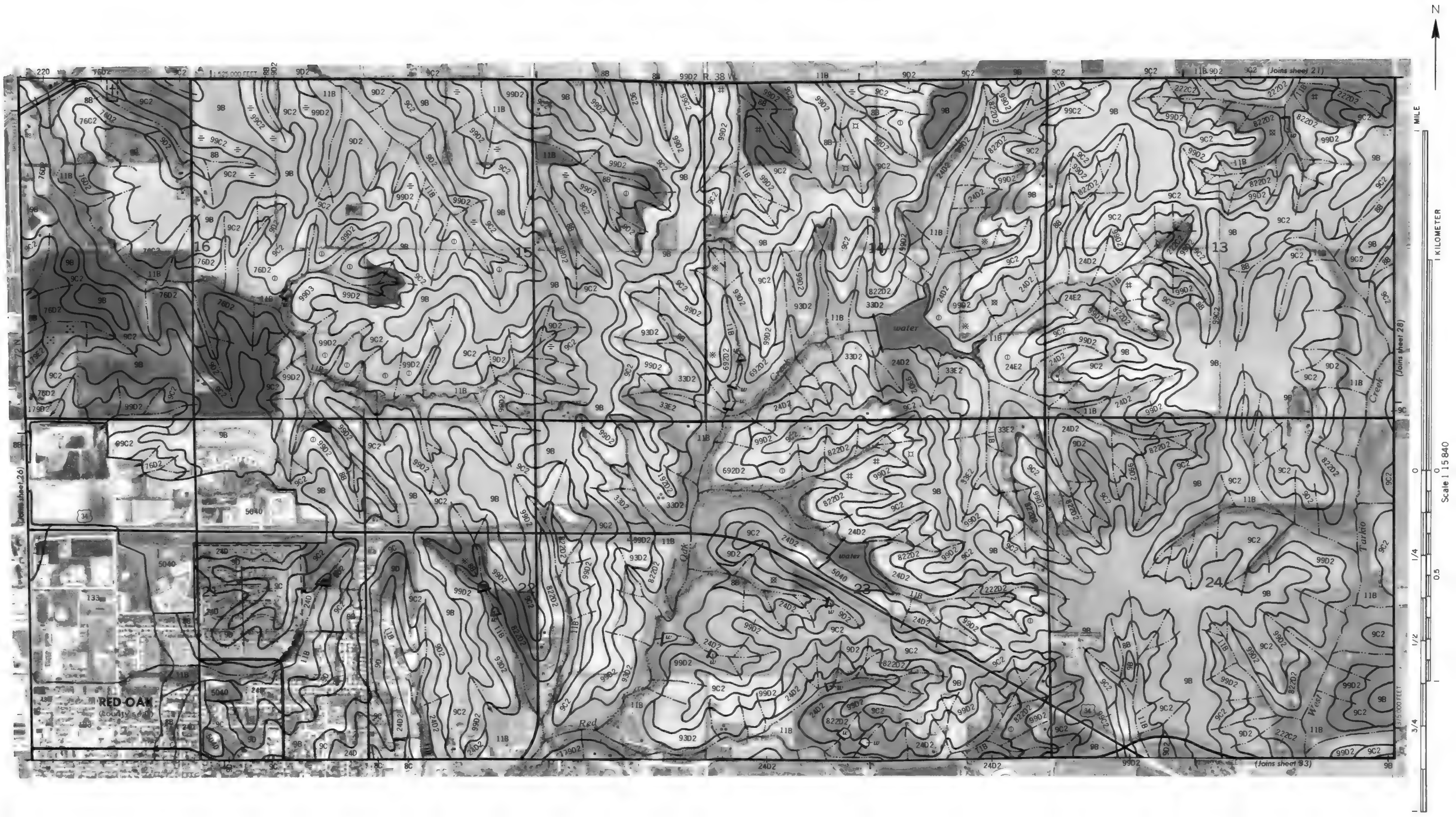


MONTGOMERY COUNTY, IOWA NO. 24


25
N
MONTGOMERY COUNTY, IOWA NO. 25
1 MILE
1 KILOMETER
Scale 1:15 840
Joins sheet 24
Joins sheet 31
MILLS COUNTY
T. 72 N.
R. 39 W.
Indian Creek
Crabapple Creek
18
17
16
19
20
21
22

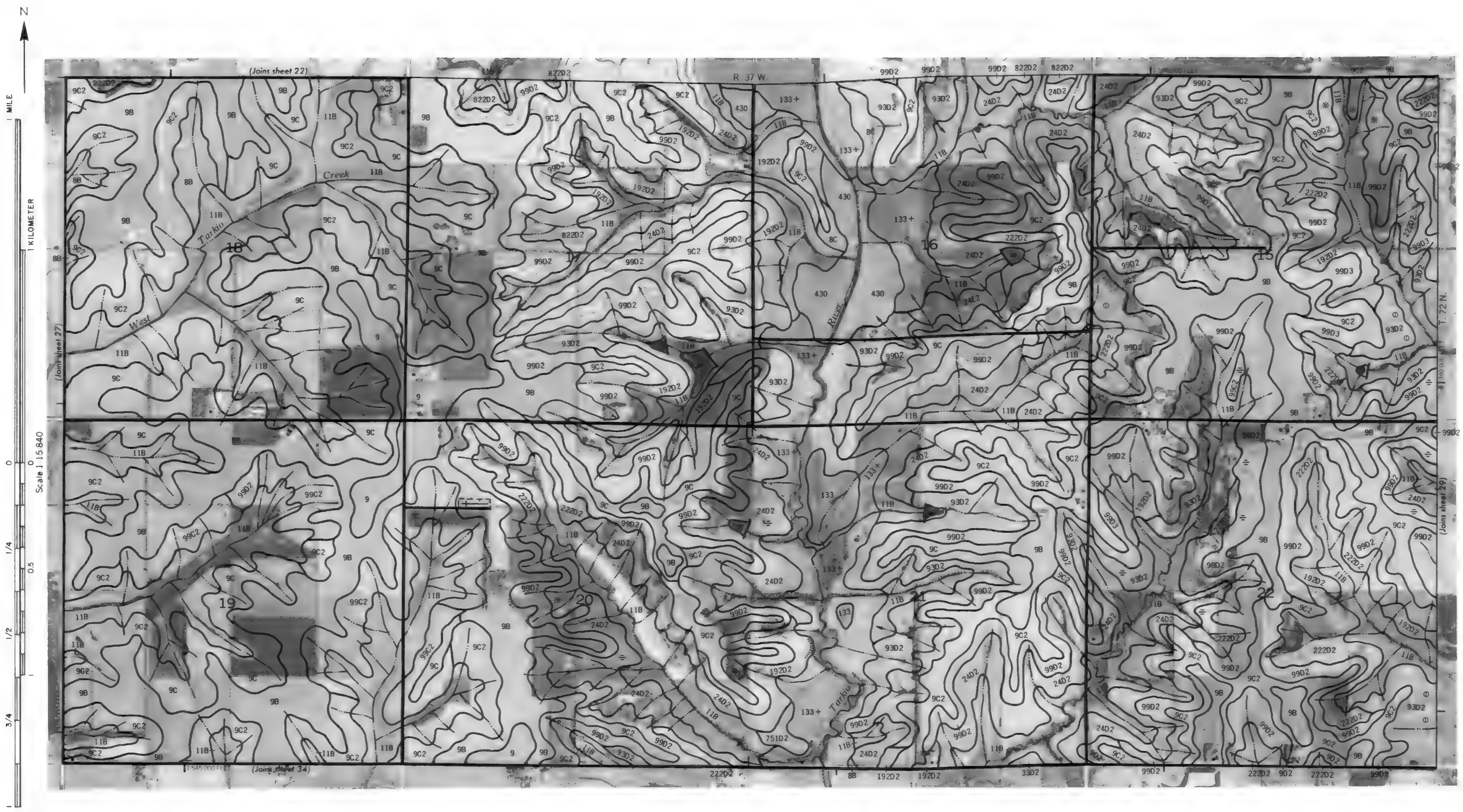


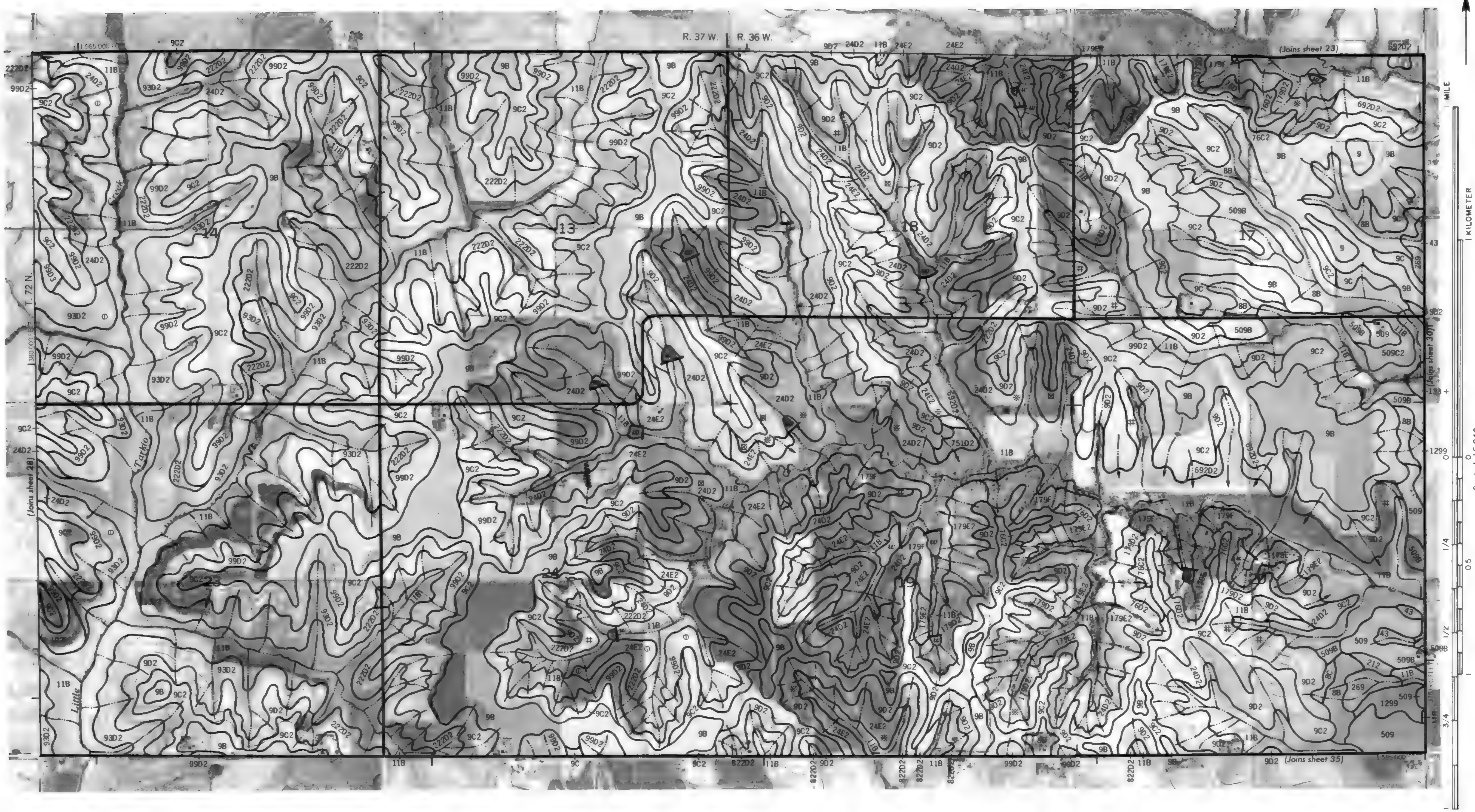
MONTGOMERY COUNTY, IOWA NO. 26



MONTGOMERY COUNTY, IOWA NO. 27

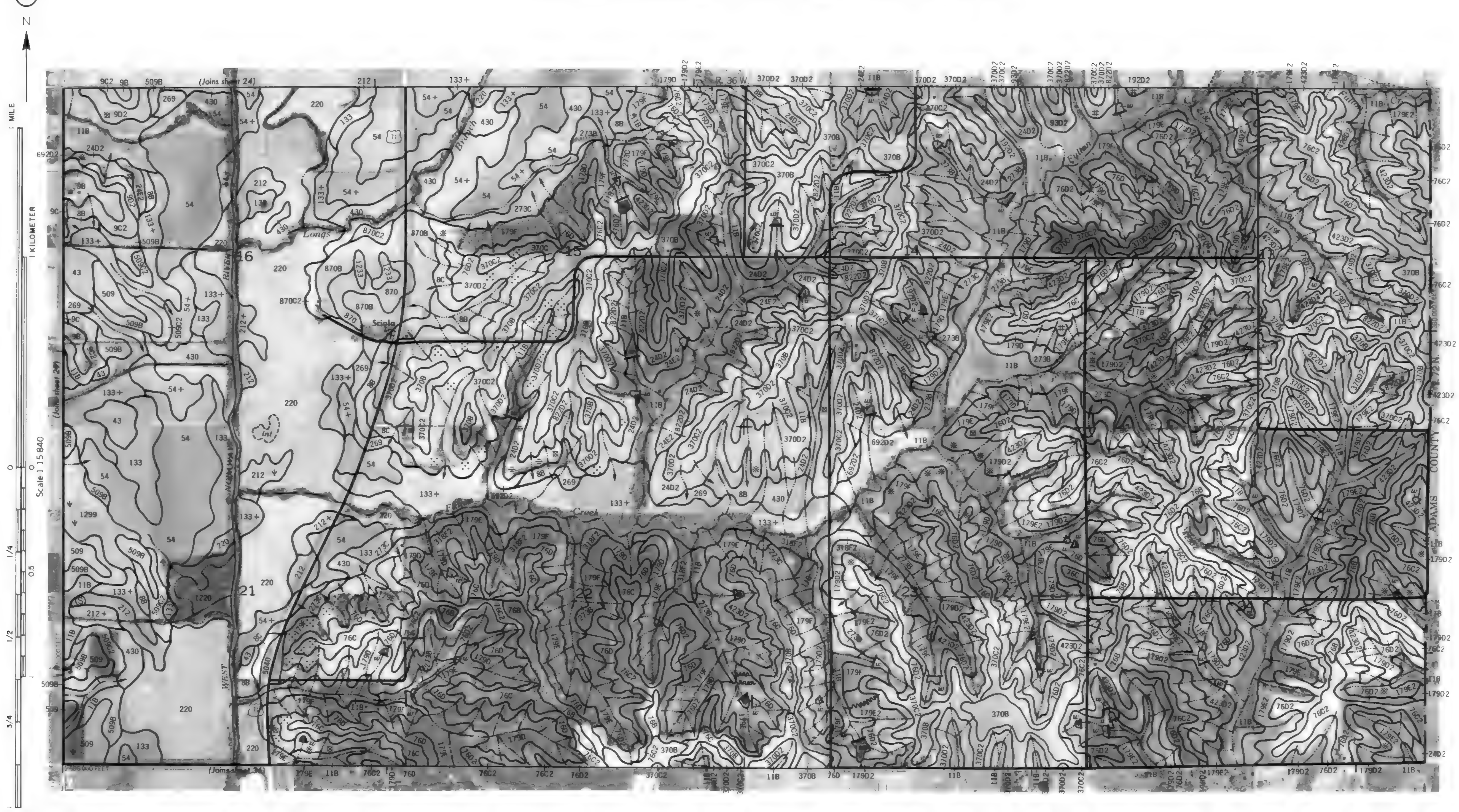
28

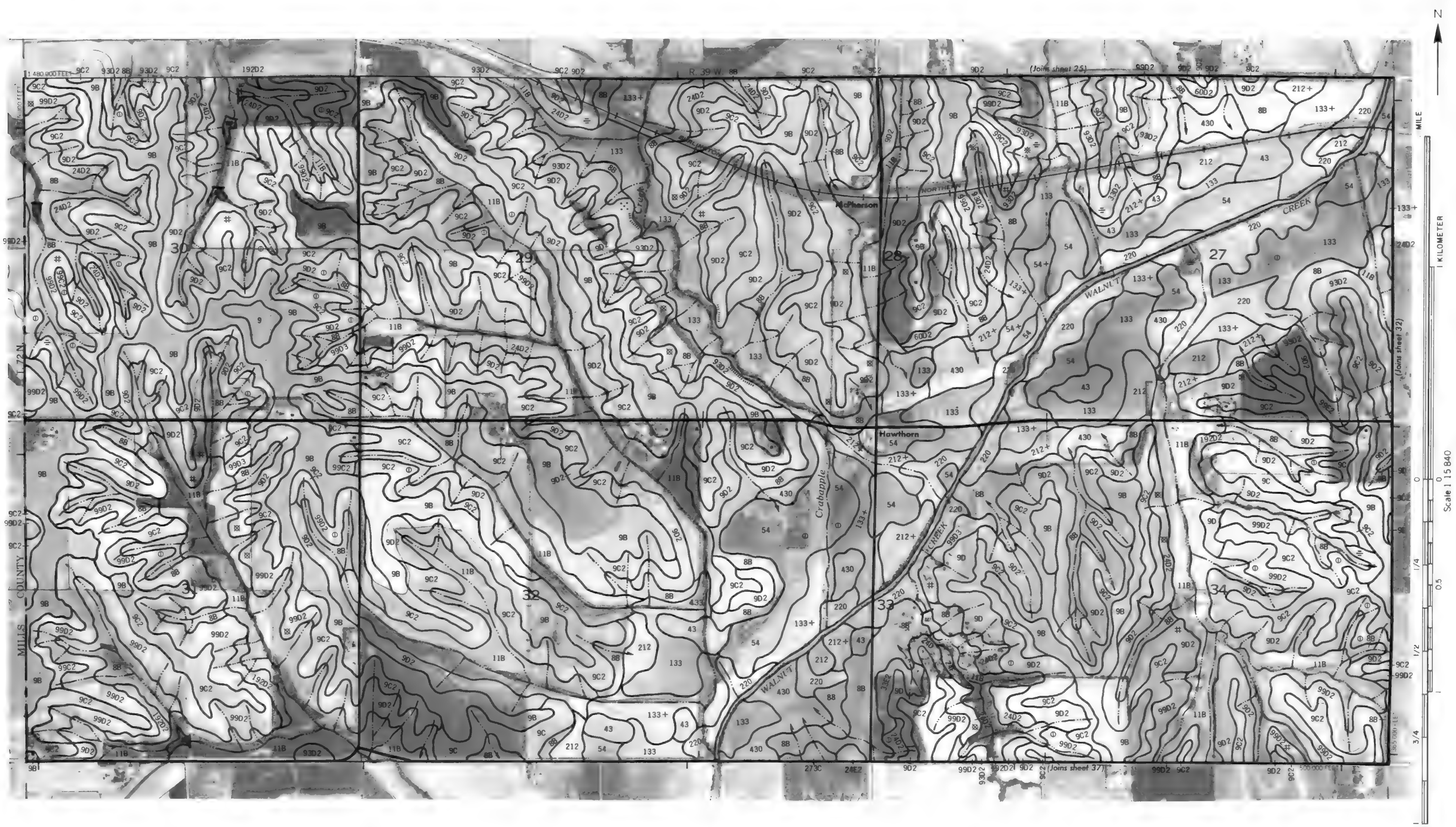

N
1 MILE
1 KILOMETER
Scale 1:15 840
(Joins sheet 22)
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 34)
R. 37 W.
T. 72 N.
West
Creek
Tarkio
River
18
17
16
15
19
20
21
22



MONTGOMERY COUNTY, IOWA NO. 29

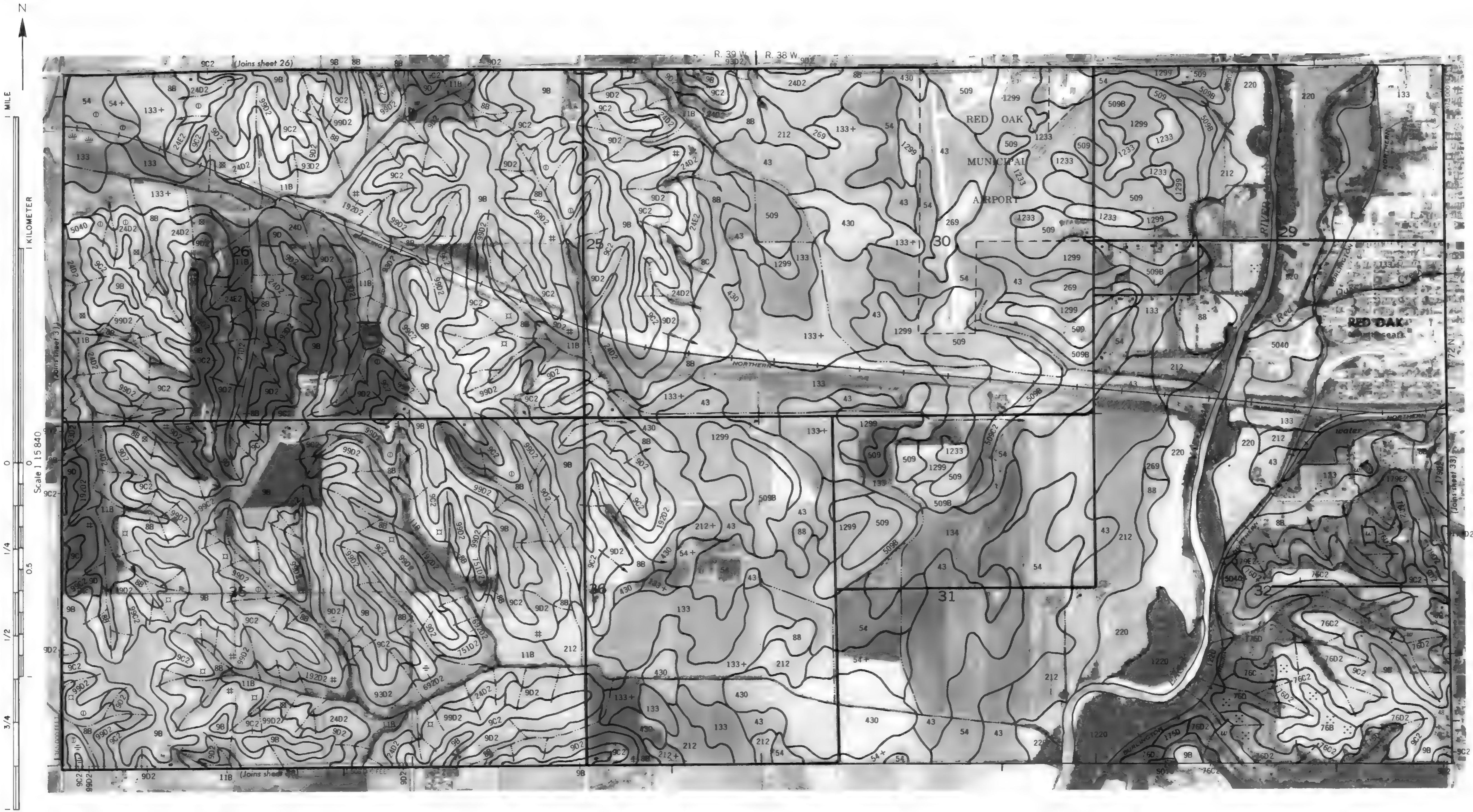
SOIL MAP OF MONTGOMERY COUNTY, IOWA — SHEET NUMBER 30

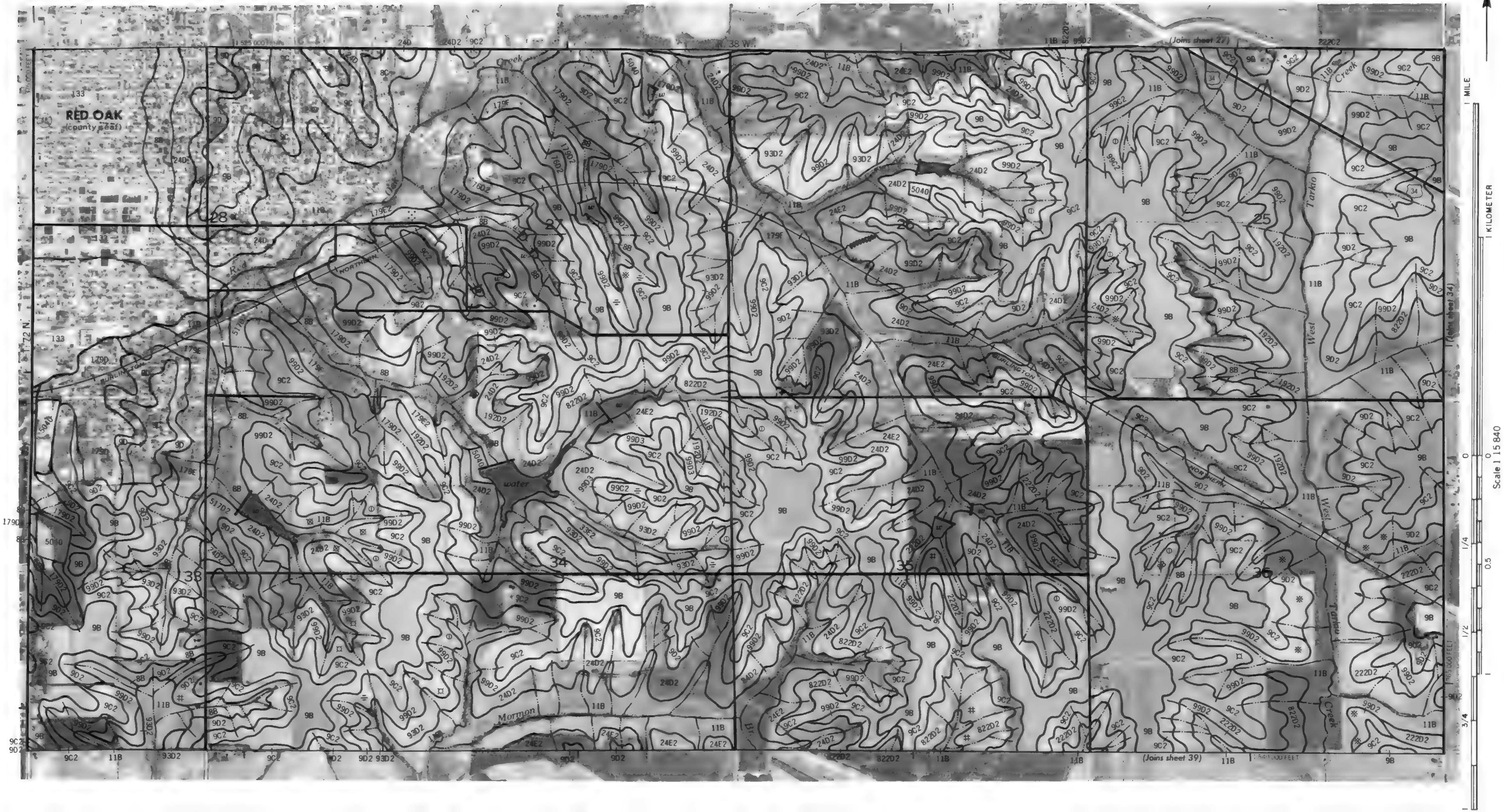


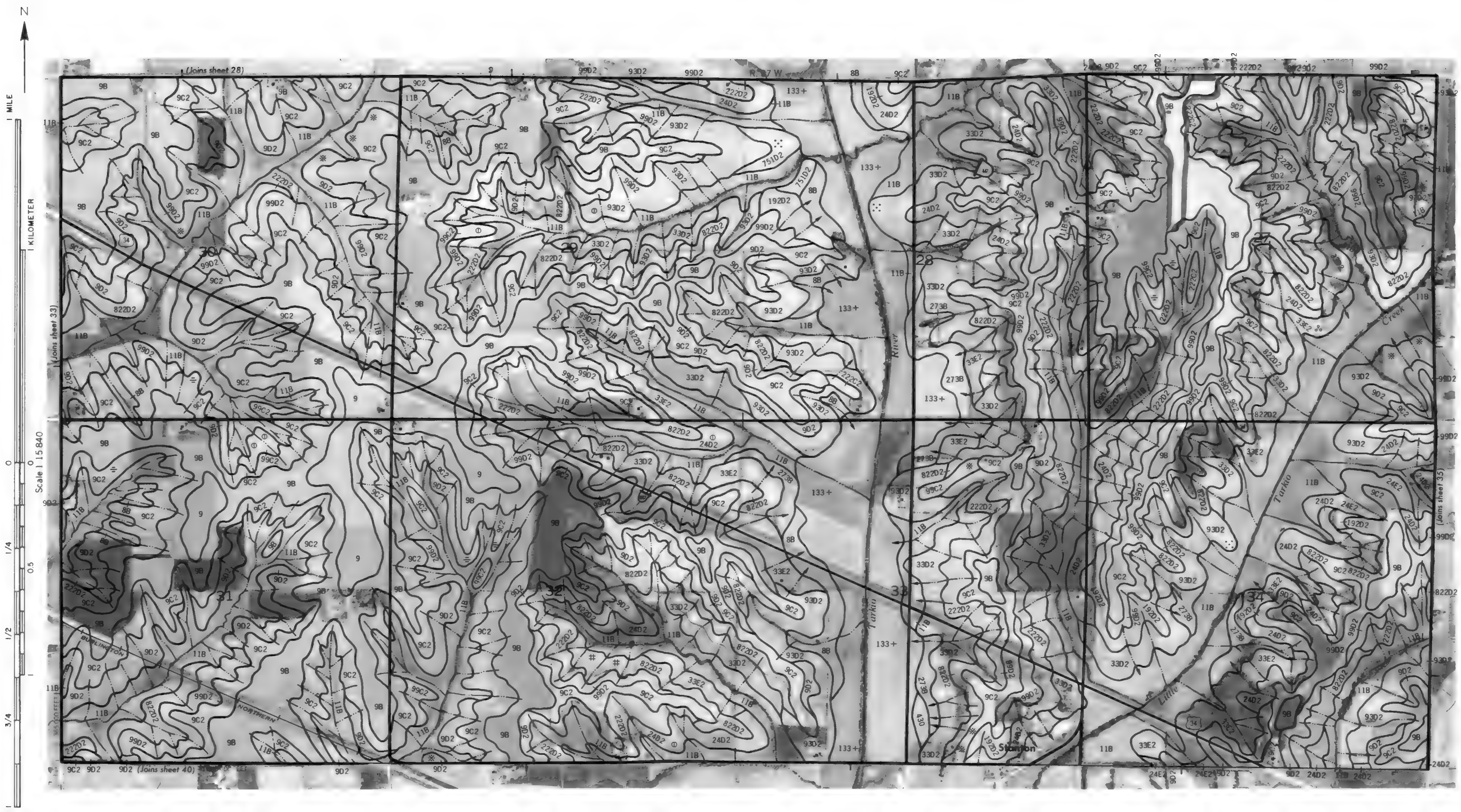


(Joins sheet 25)
(Joins sheet 32)
(Joins sheet 37)
R. 39 W.
T. 72 N.
McPherson
Hawthorn
WALNUT CREEK
Crabapple
MILLS COUNTY
N
MILE
1 KILOMETER
Scale 1:15 840

32

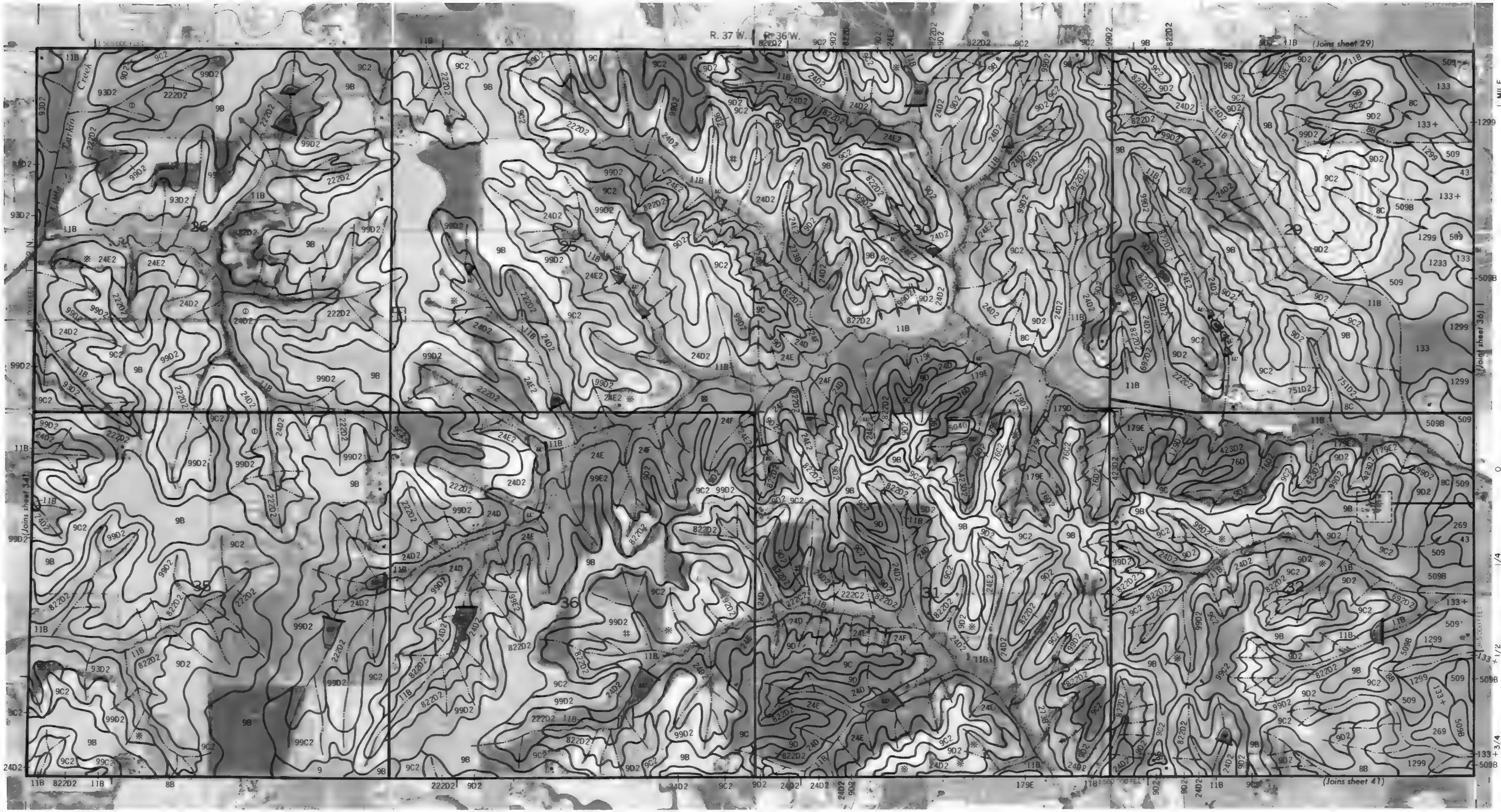

N
MILE
KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
R. 39 W.
R. 38 W.
(Joins sheet 26)
RED OAK
MUNICIPAL
AIRPORT
RED OAK
NORTHERN
RIVER
water
(Joins sheet 33)
(Joins sheet 31)
T. 72 N.
25
26
29
30
31
32
35
36

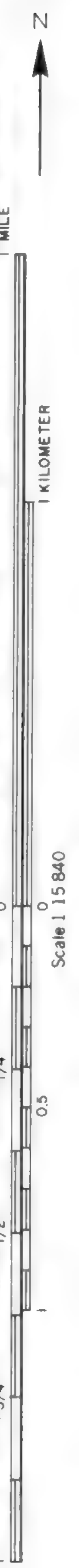

RED OAK
(county seat)
water
Creek
Red Oak
Tarkio
West Tarkio Creek
Mormon
BURLINGTON
NORTHERN
(Joins sheet 27)
(Joins sheet 34)
(Joins sheet 39)
R. 38 W.
T. 72 N.
28
27
26
25
33
34
35
36
N
1 MILE
1 KILOMETER
Scale 1:15 840


N
1 MILE
1 KILOMETER
Scale 1:15 840
(Joins sheet 28)
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 40)
R. 37 W.
Tarkio River
Little Tarkio Creek
Stanton
BURLINGTON
NORTHERN

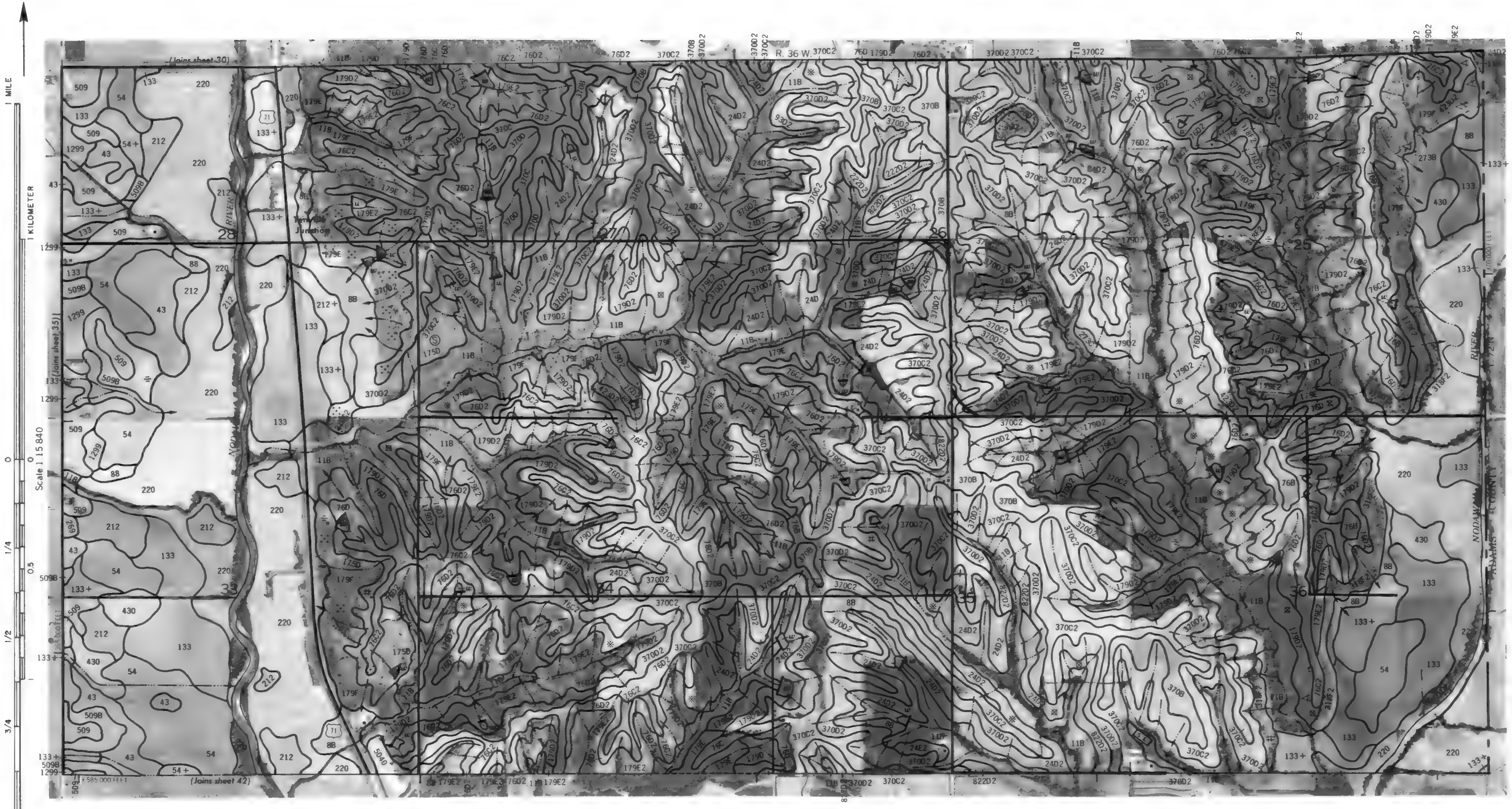
35

MONTGOMERY COUNTY, IOWA NO. 35





SOIL MAP OF MONTGOMERY COUNTY, IOWA — SHEET NUMBER 36

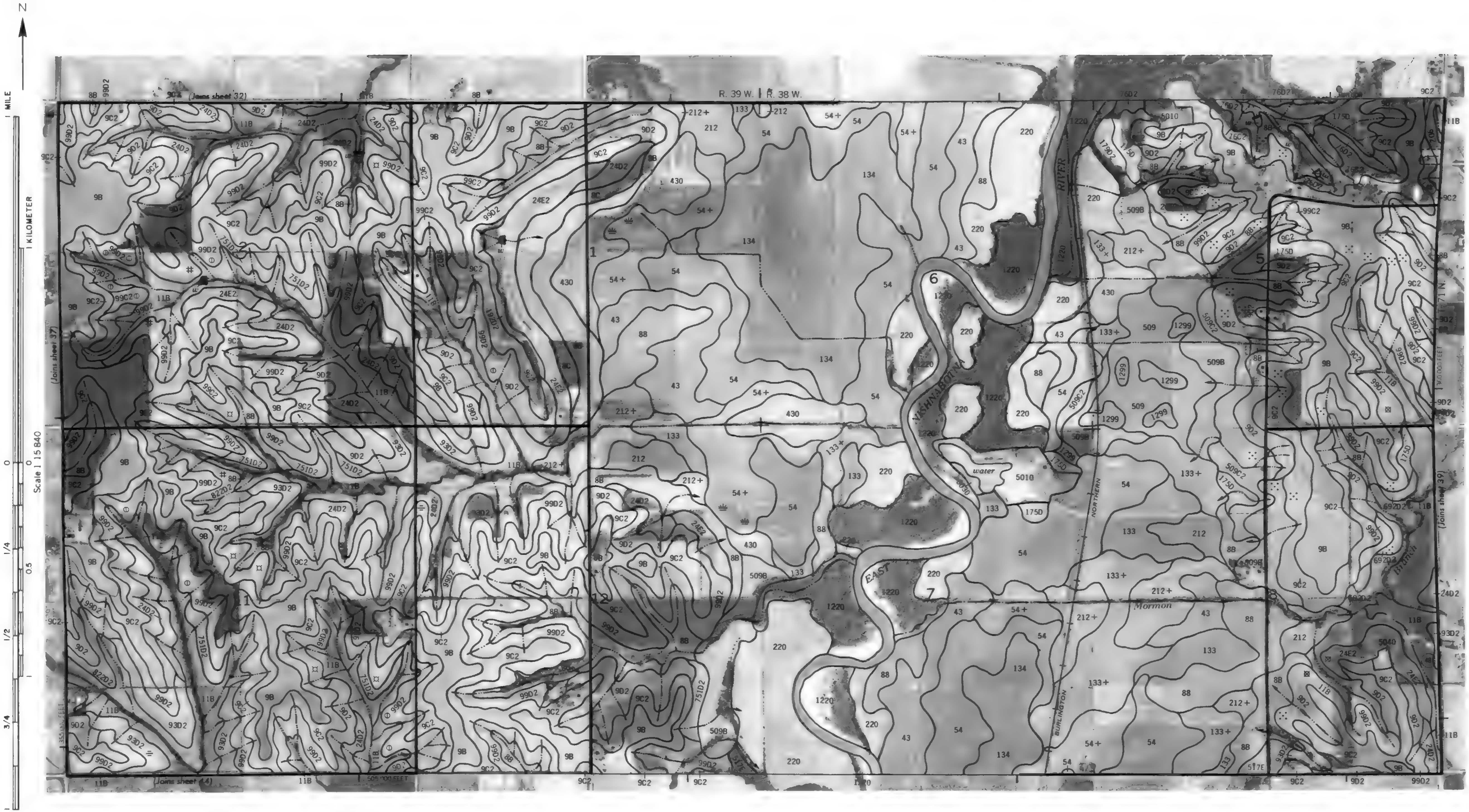


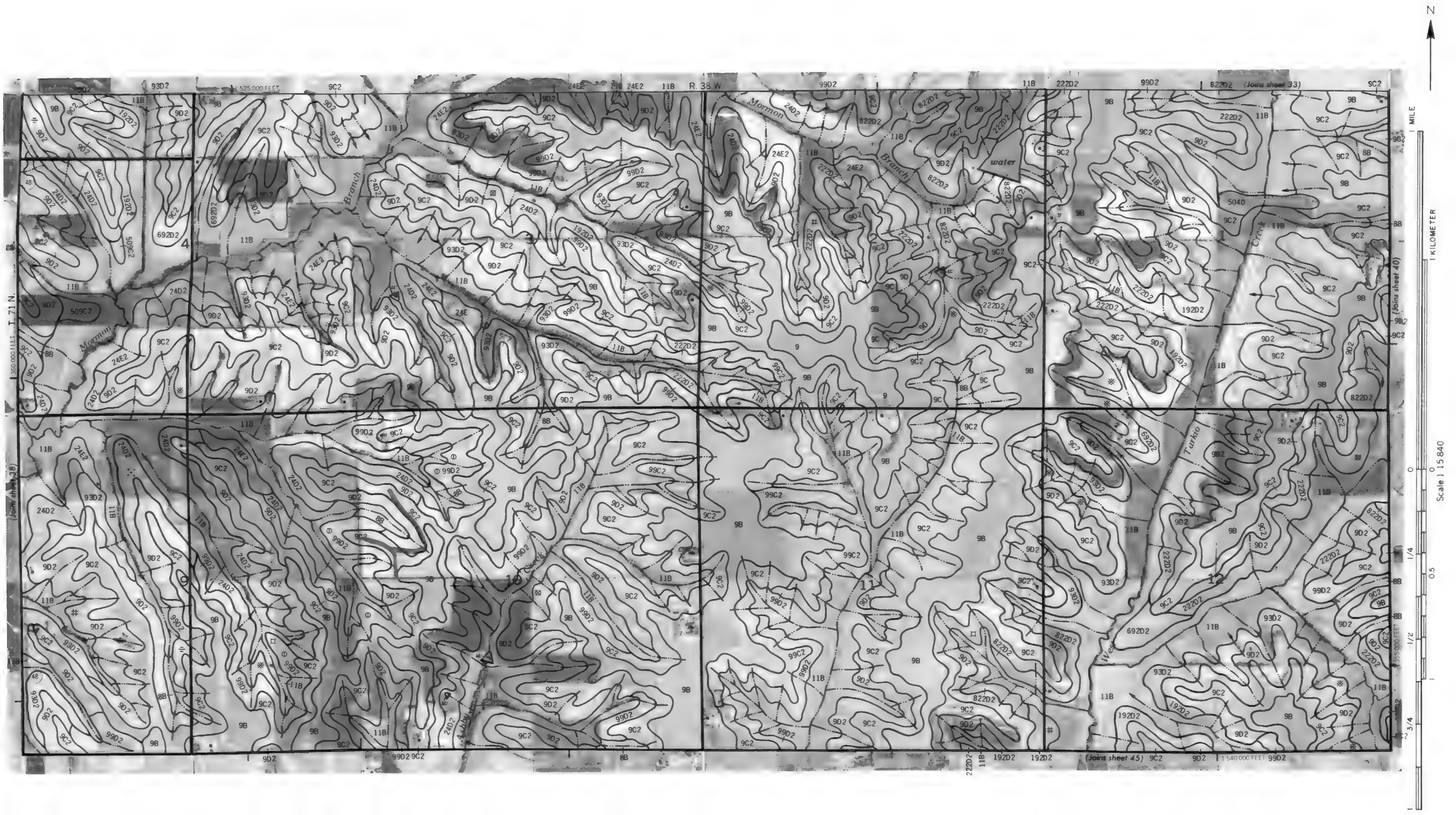
MONTGOMERY COUNTY, IOWA NO. 36

37

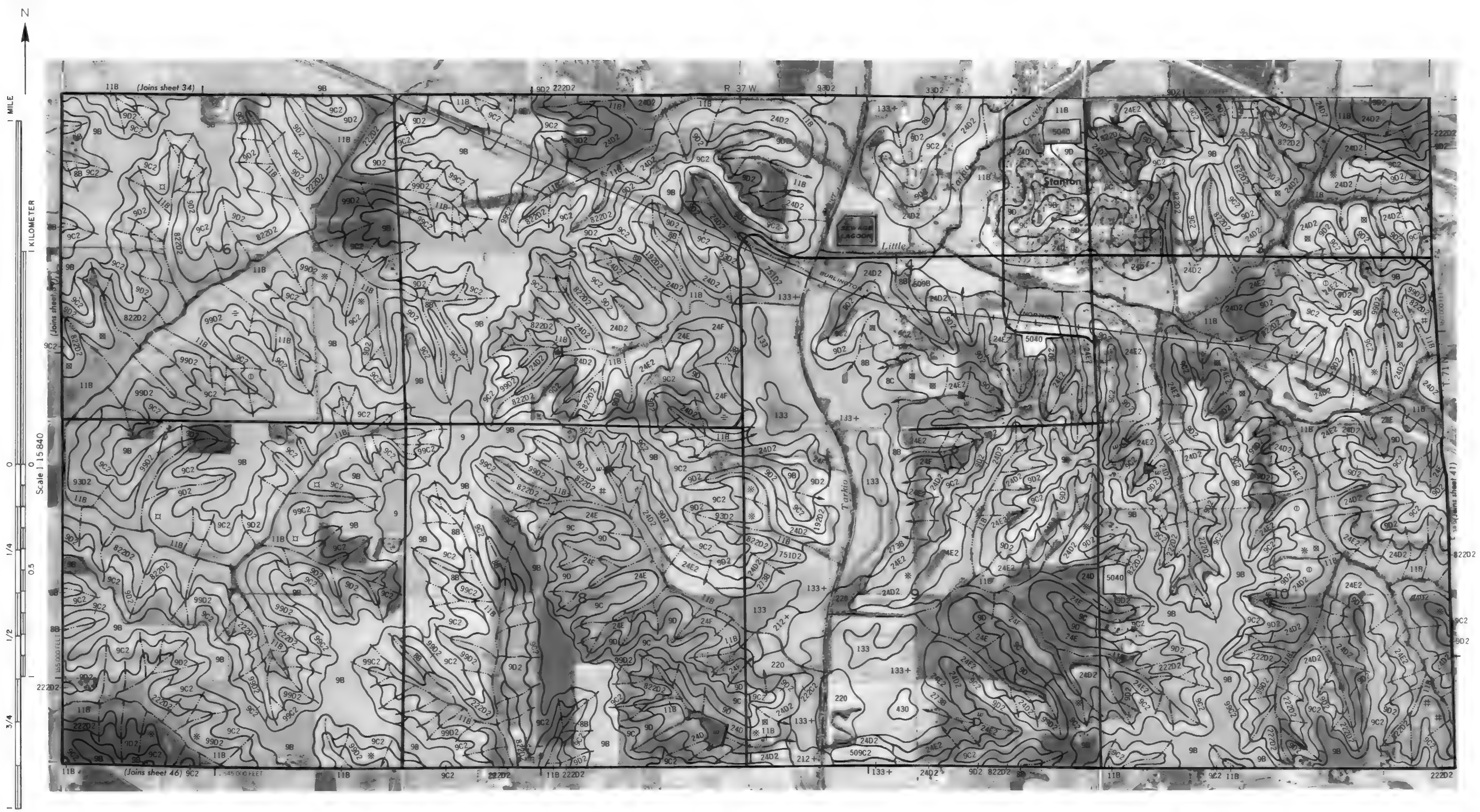
MONTGOMERY COUNTY, IOWA NO. 37

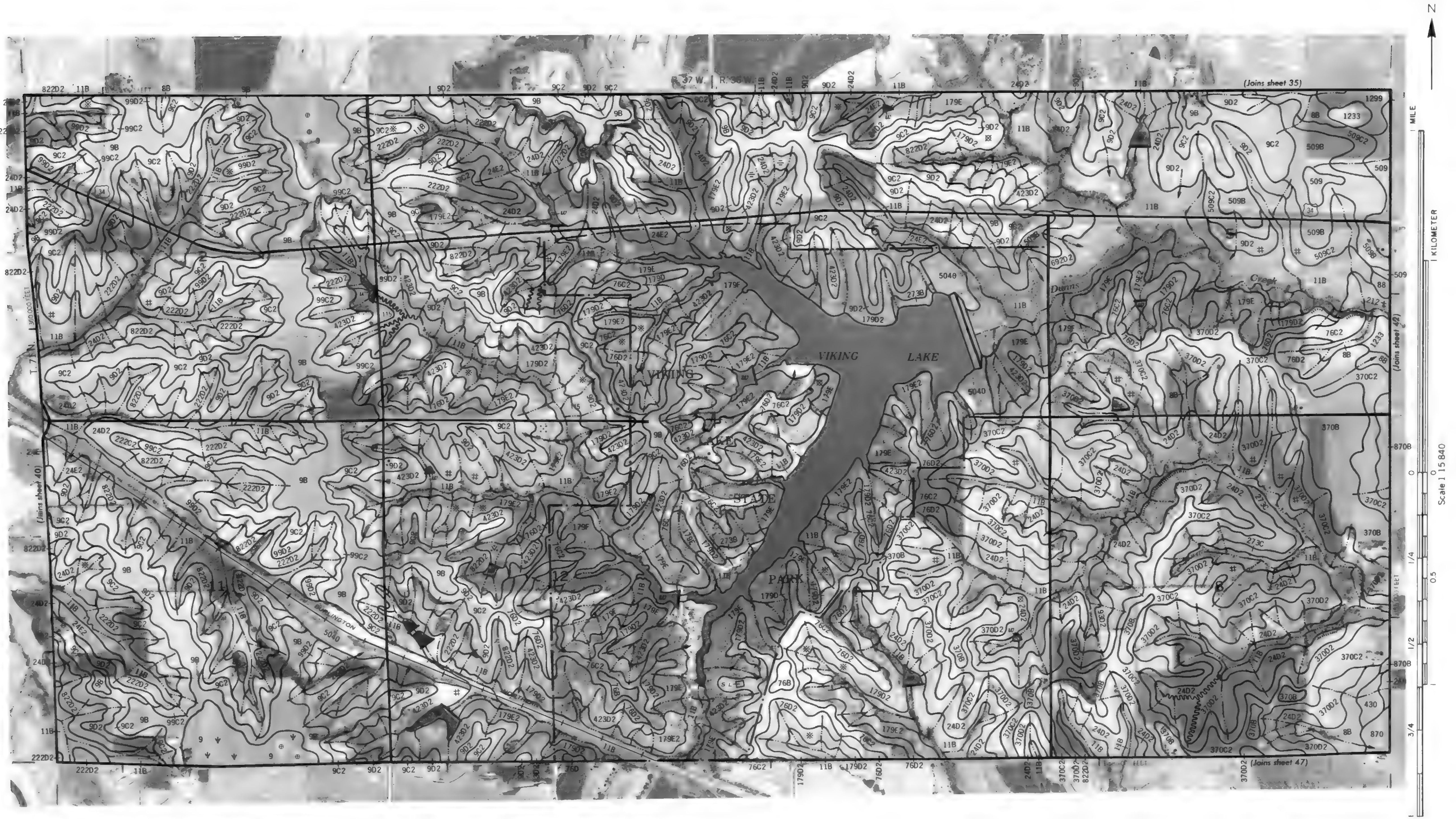
SOIL MAP OF MONTGOMERY COUNTY, IOWA — SHEET NUMBER 38




39
N
R. 38 W
T. 71 N.
(Joins sheet 33)
(Joins sheet 40)
(Joins sheet 45)
(Joins sheet 38)
water
Mormon
Branch
Tarkio
Creek
1 525 000 FEET
1 540 000 FEET
1 MILE
1 KILOMETER
Scale 1:15 840

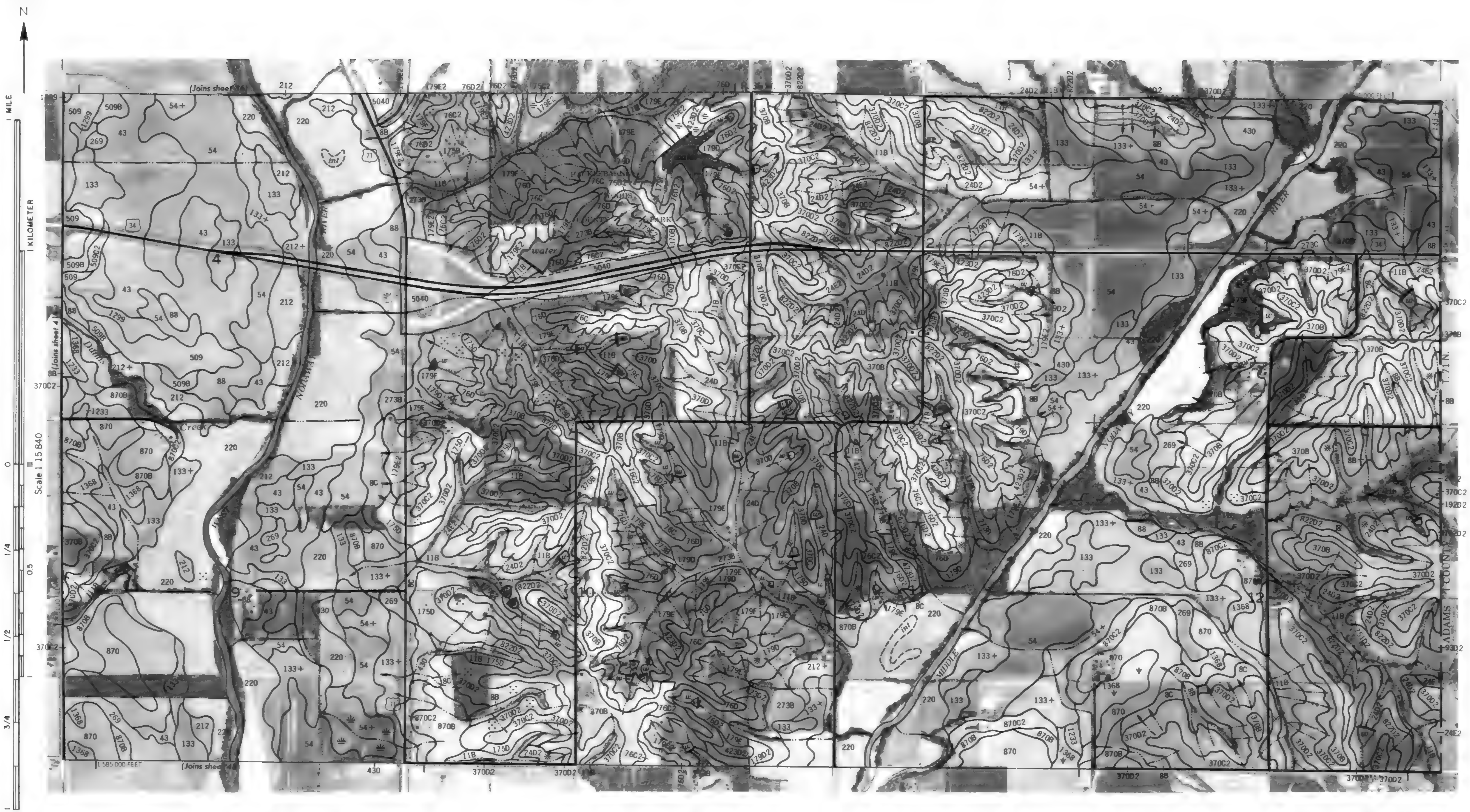
SOIL MAP OF MONTGOMERY COUNTY, IOWA — SHEET NUMBER 40

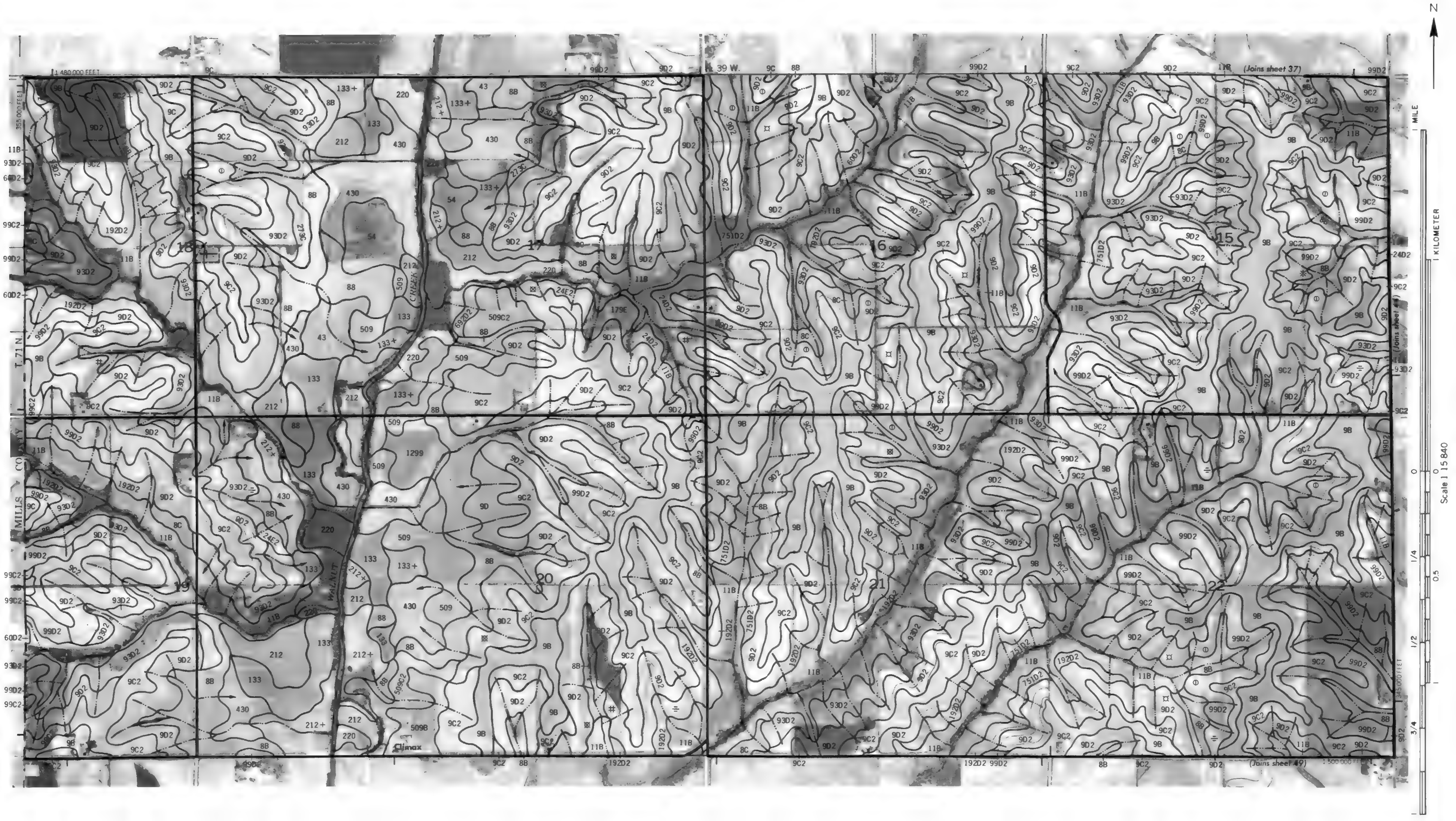




MONTGOMERY COUNTY, IOWA NO. 41

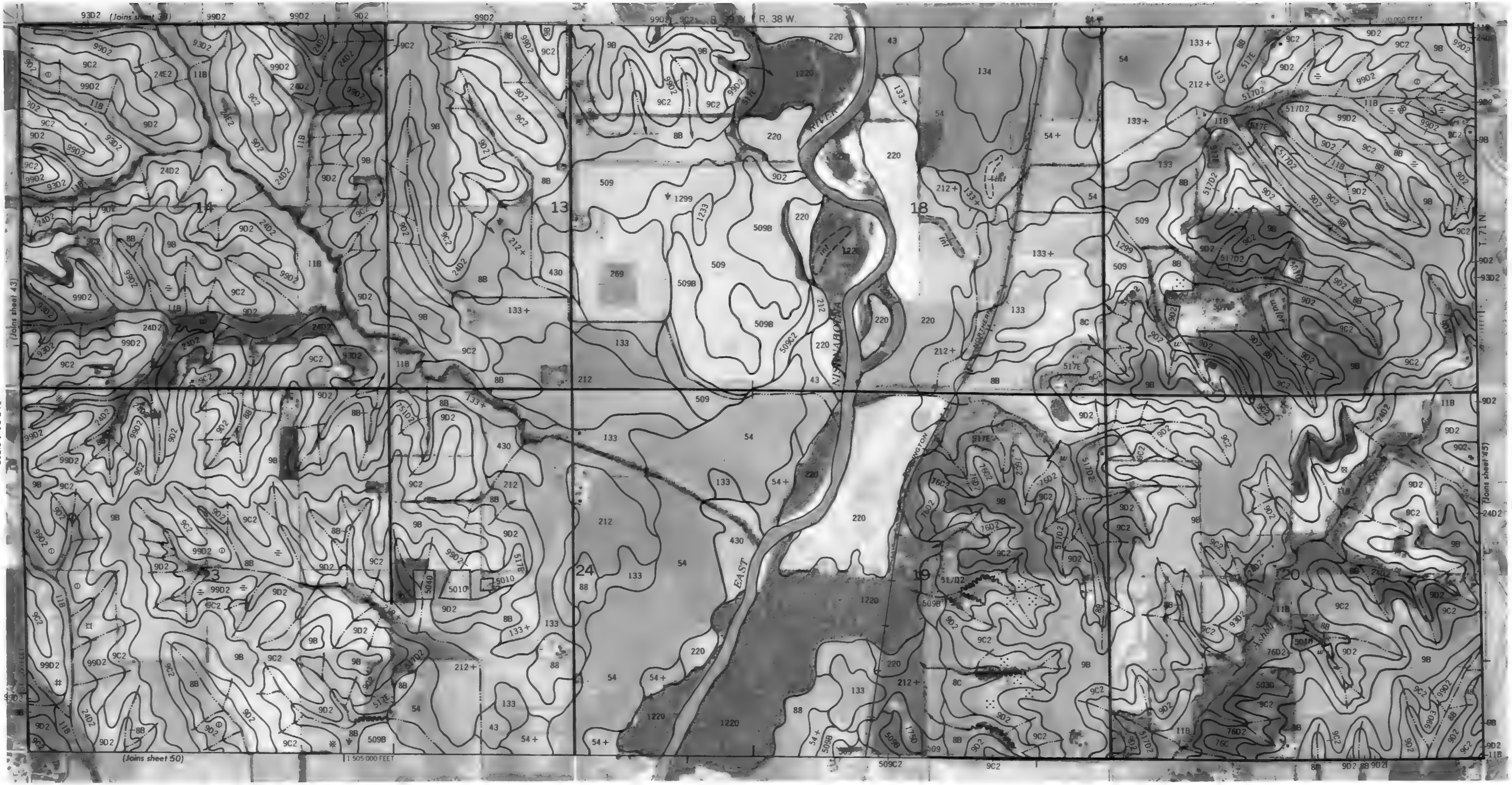
SOIL MAP OF MONTGOMERY COUNTY, IOWA — SHEET NUMBER 42

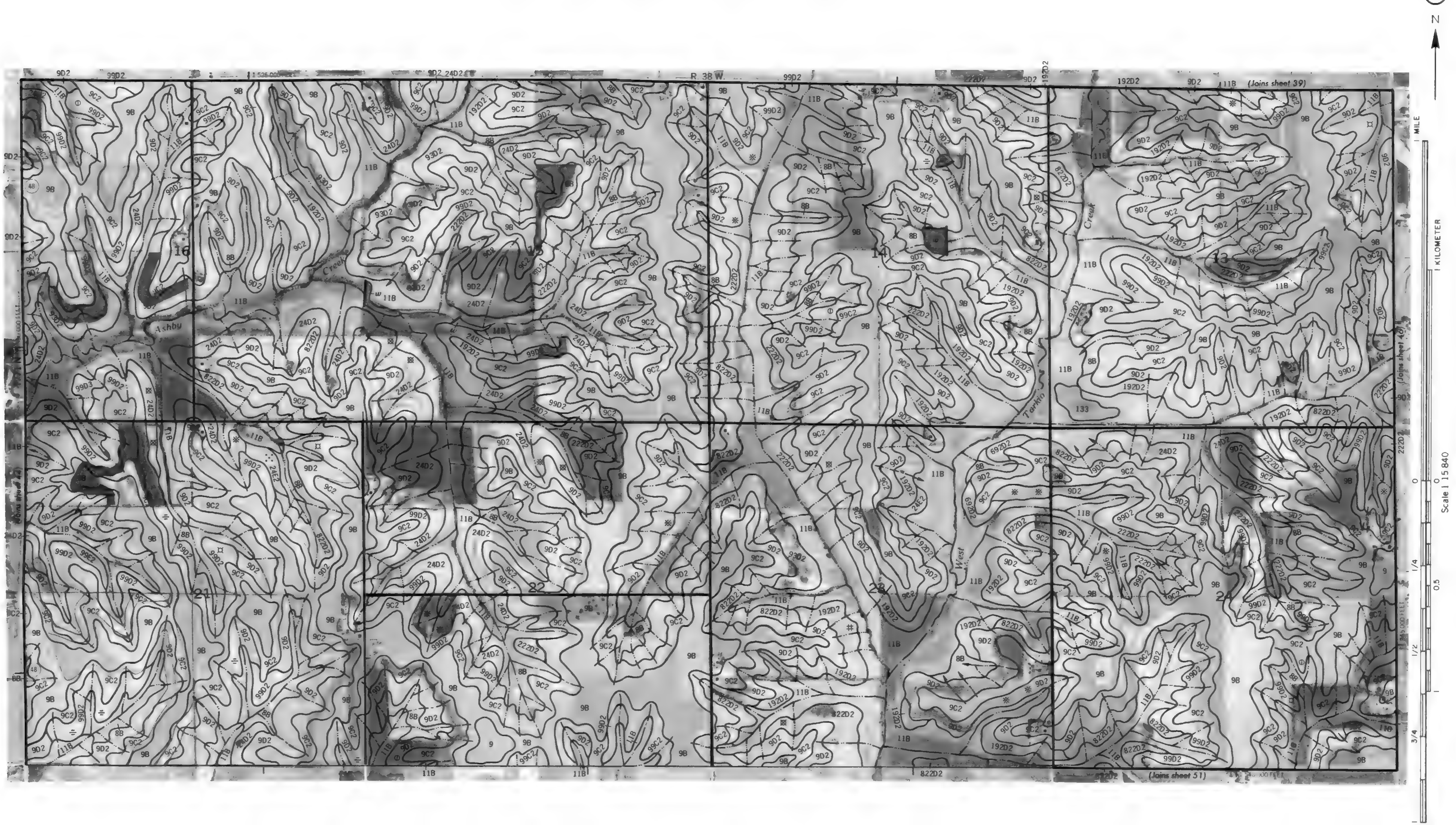



(Joins sheet 37)
(Joins sheet 49)
1 480 000 FEET
39 W.
T. 71 N.
MILLS COUNTY
WALNUT
CREEK
Climax
N
1 MILE
1 KILOMETER
Scale 1:15 840

N

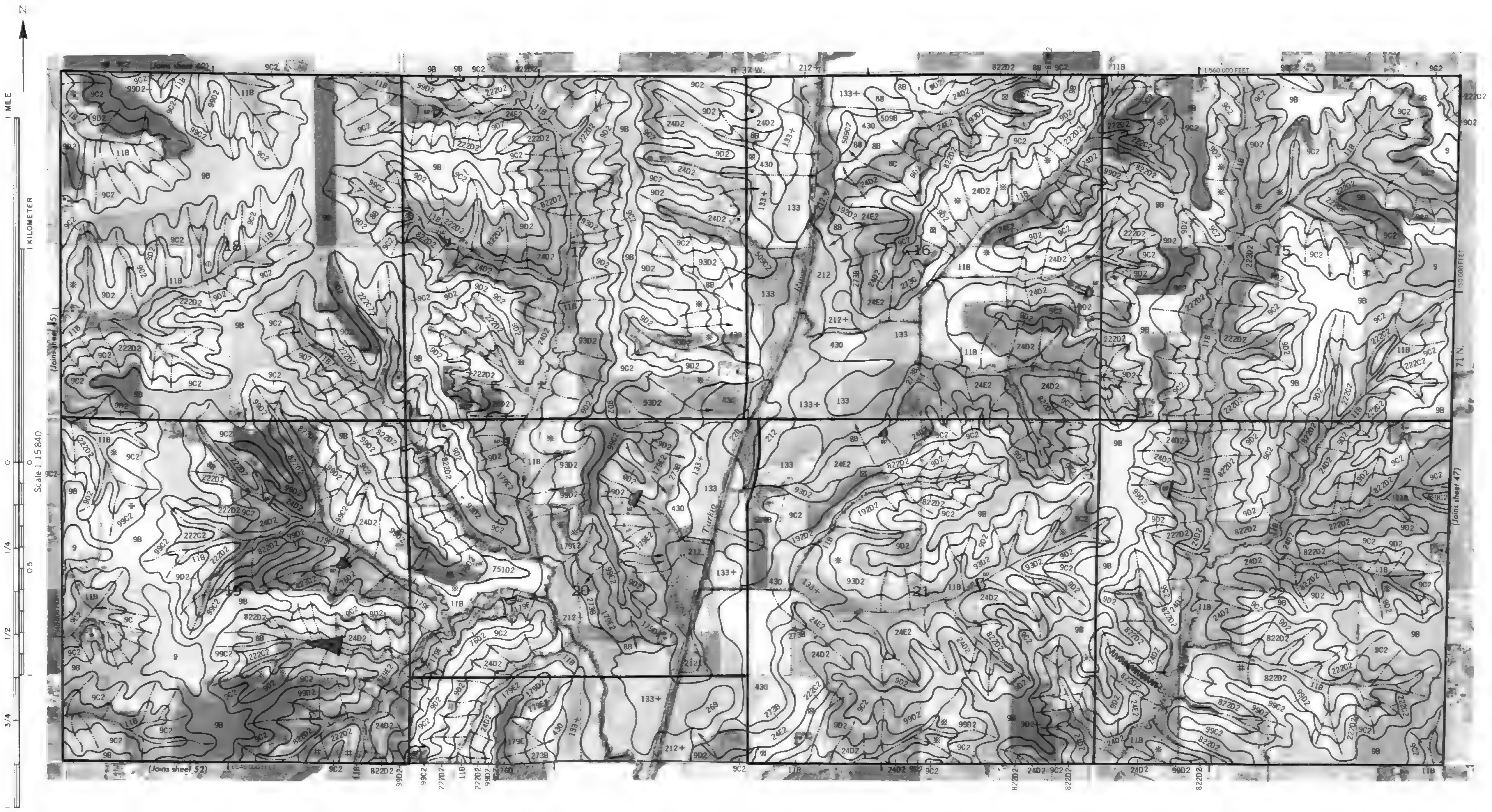
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
0.5
1/2
1
3/4

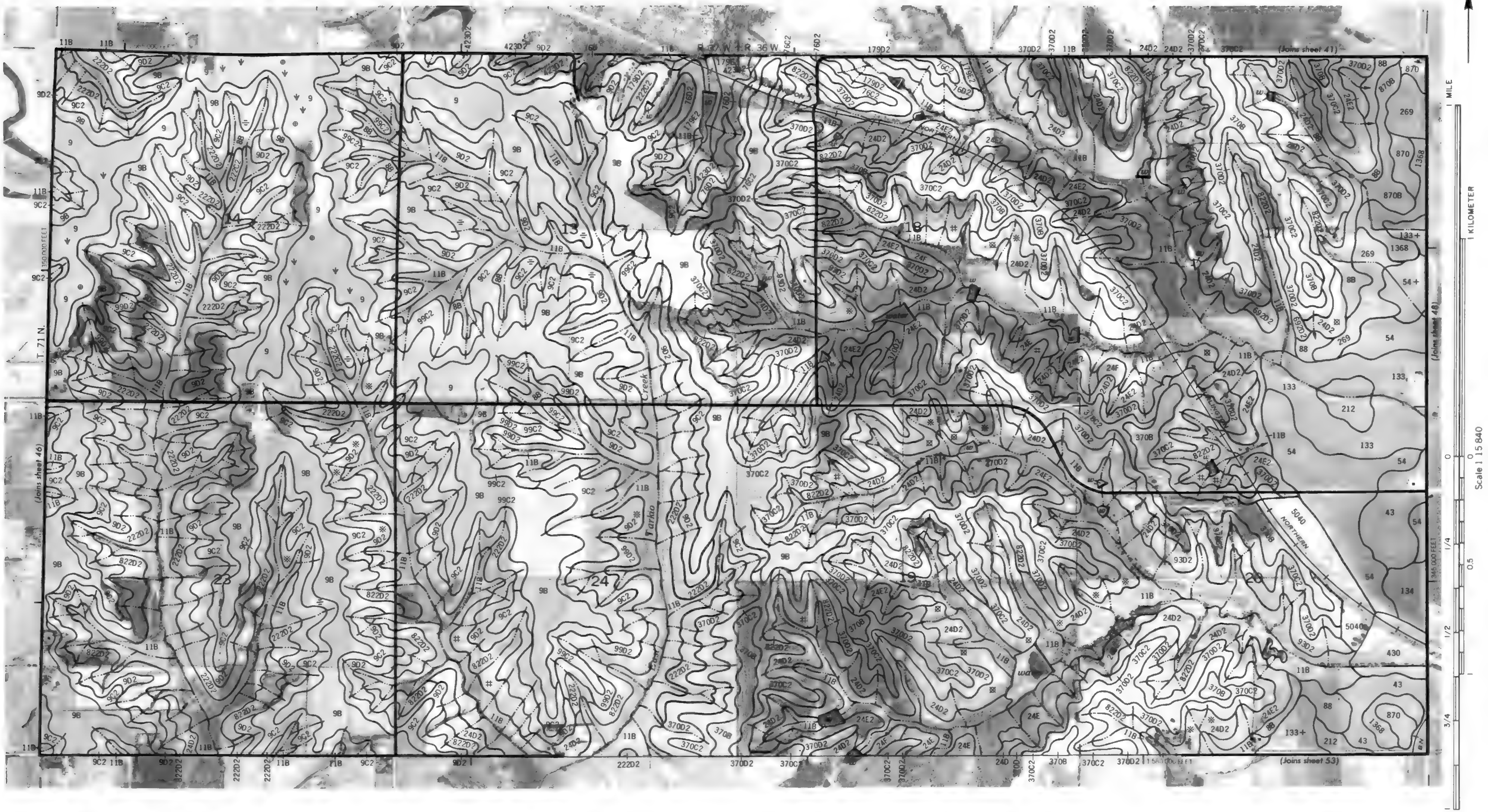


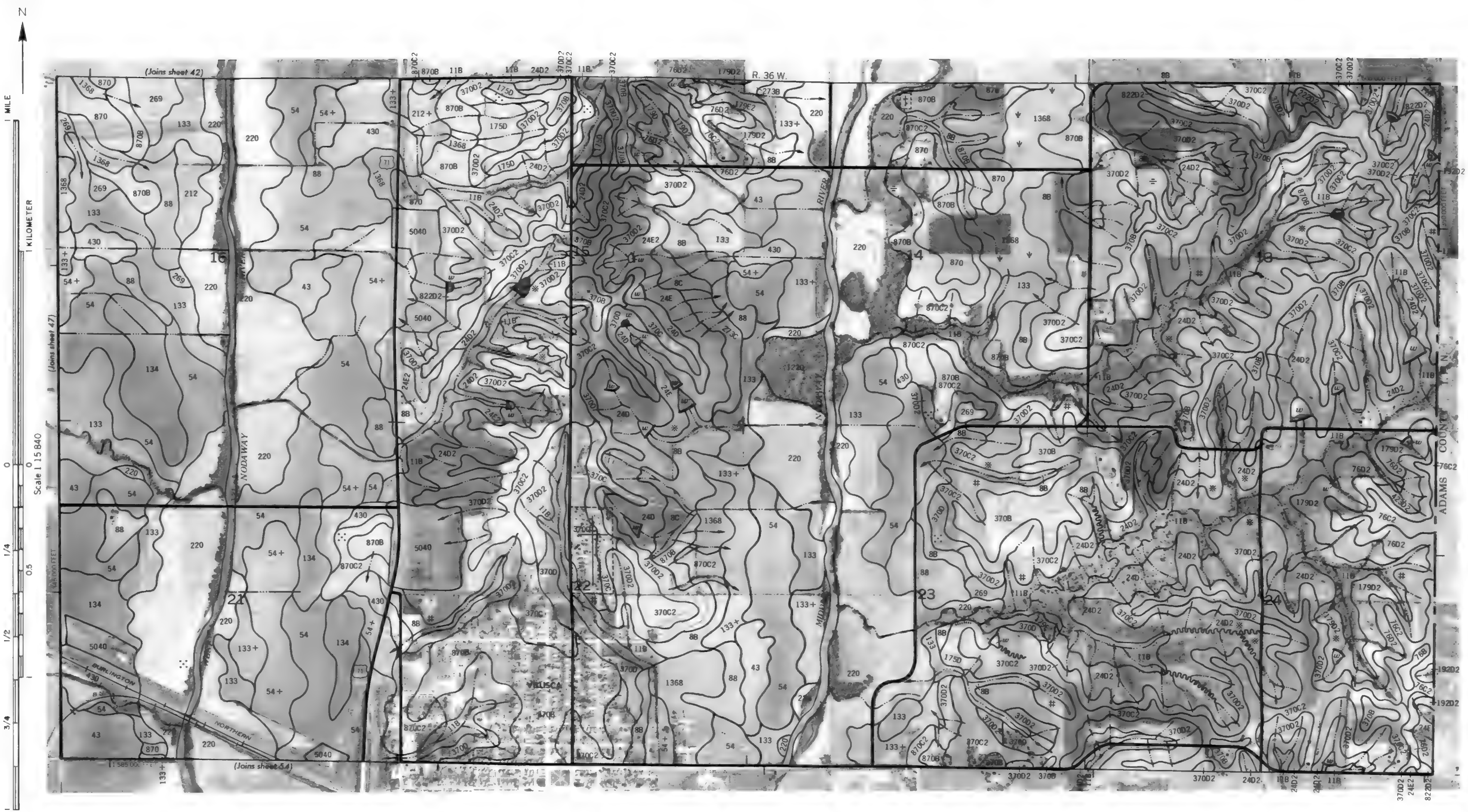


MONTGOMERY COUNTY, IOWA NO. 45

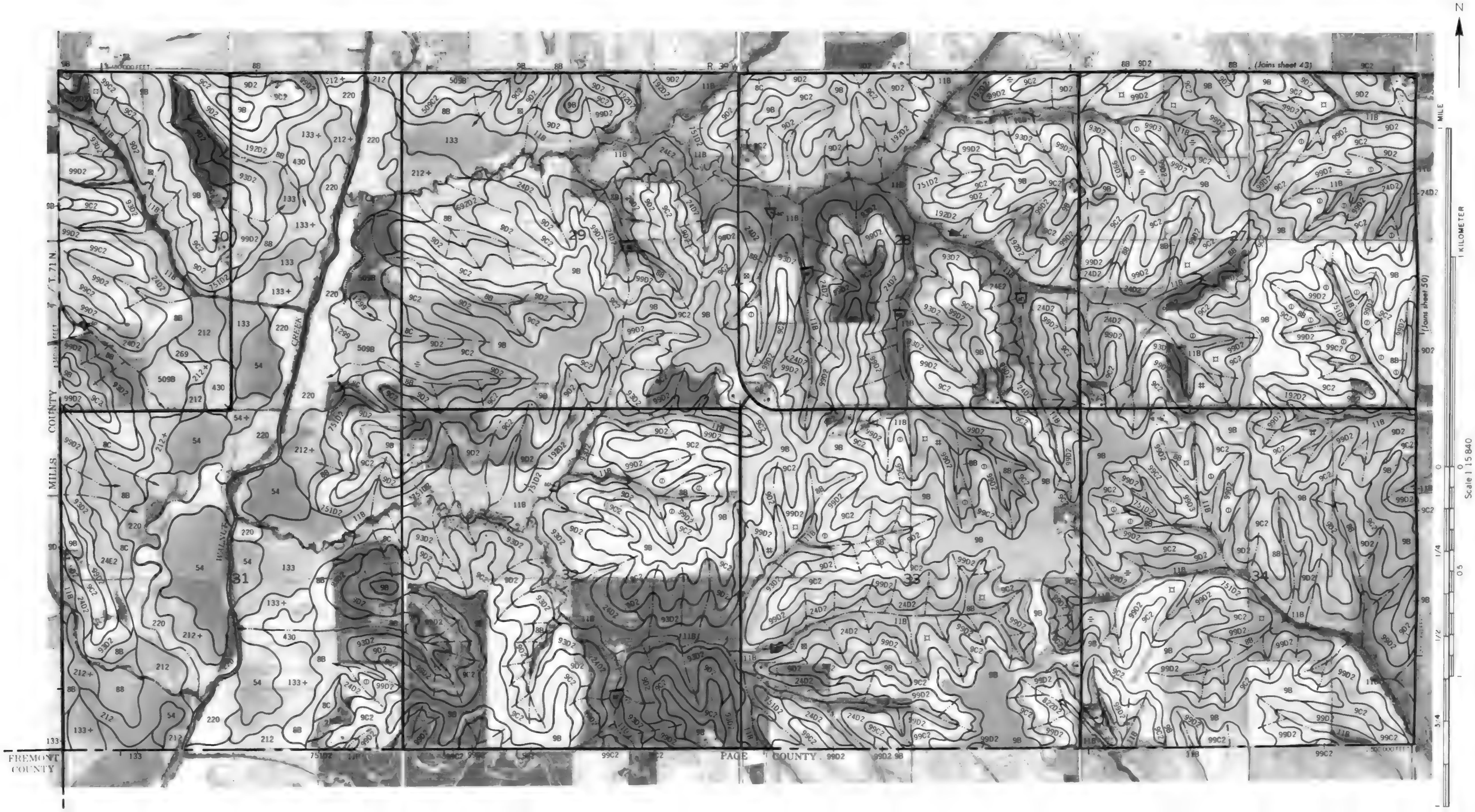
46


N
1 MILE
1 KILOMETER
Scale 1:15 840
(Joins sheet 40)
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 52)
R. 37 W.
71 N.
1 560 000 FEET
Turkio
18
17
16
15
19
20
21
22


(Joins sheet 41)
(Joins sheet 46)
(Joins sheet 48)
(Joins sheet 53)
R. 37 W. | R. 36 W.
T. 71 N.
Tarkio Creek
NORTHERN
14
13
18
23
24
19
20
N
1 MILE
1 KILOMETER
Scale 1:15 840



MONTGOMERY COUNTY, IOWA NO. 48

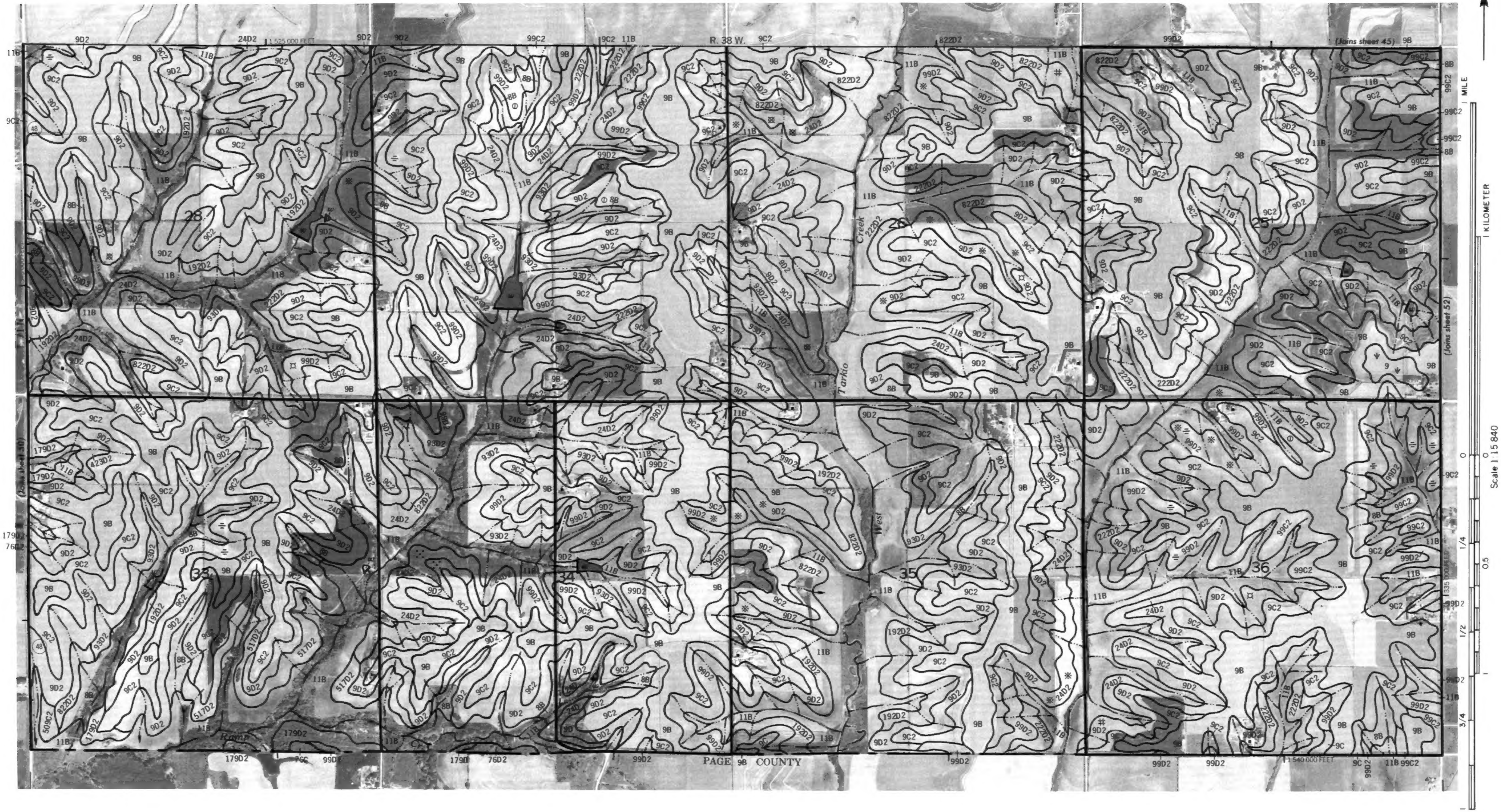


N
(Joins sheet 43)
(Joins sheet 50)
MILLS COUNTY
T. 71 N.
WALNUT CREEK
FREMONT COUNTY
PAGE COUNTY
30
29
28
27
31
32
33
34
1 MILE
1 KILOMETER
Scale 1:15 840

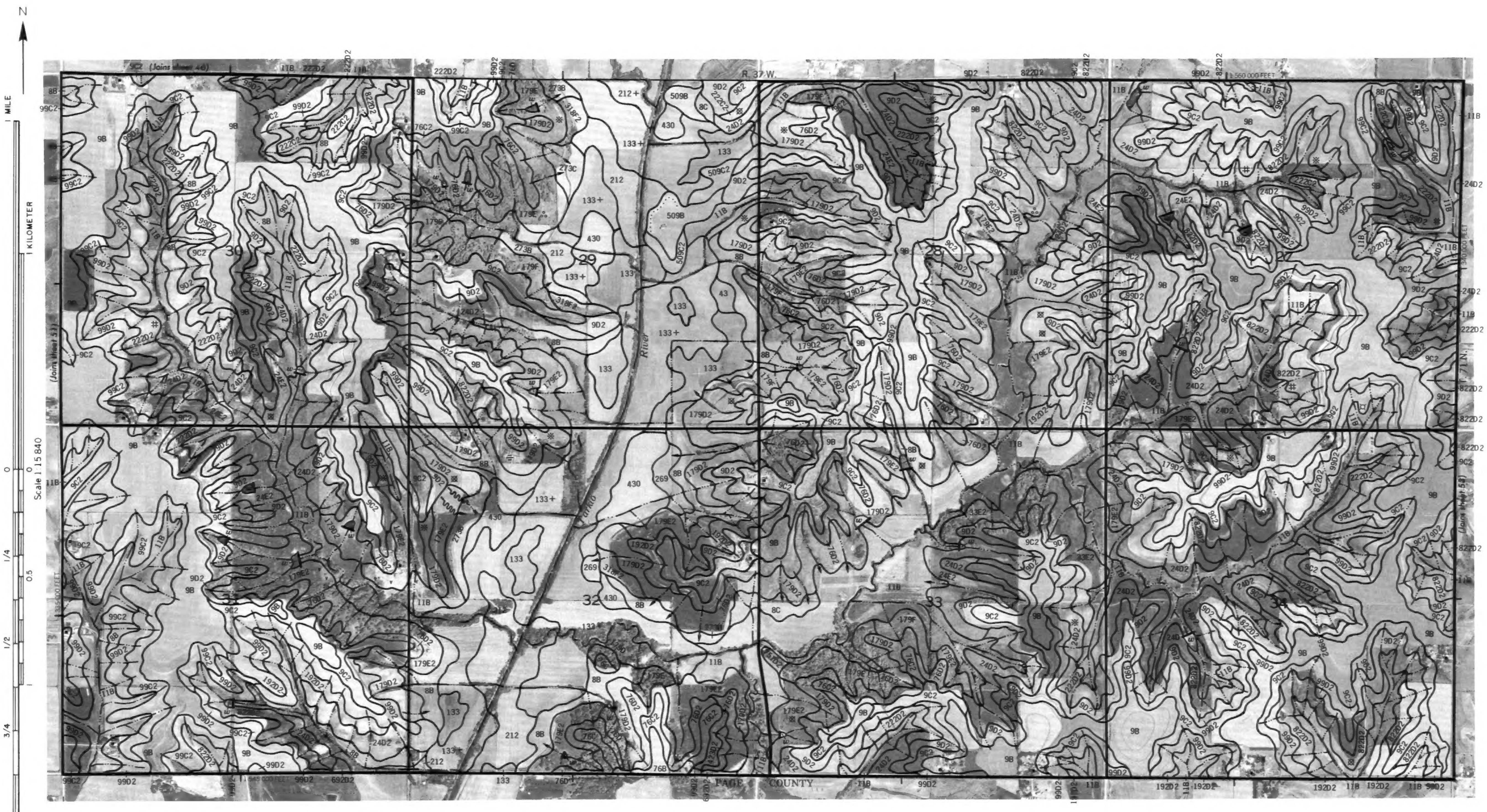

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0
0.5
1
(Joins sheet 44)
(Joins sheet 49)
(Joins sheet 51)
R. 39 W. | R. 38 W.
T. 71 N.
PAGE COUNTY
Coburg
NISHNABOTNA
RIVER
EAST
BURLINGTON
NORTHERN
Ramp
Creek
Ashby
25
26
29
30
31
32
35
36
335 000 FEET
1 905 000 FEET

51

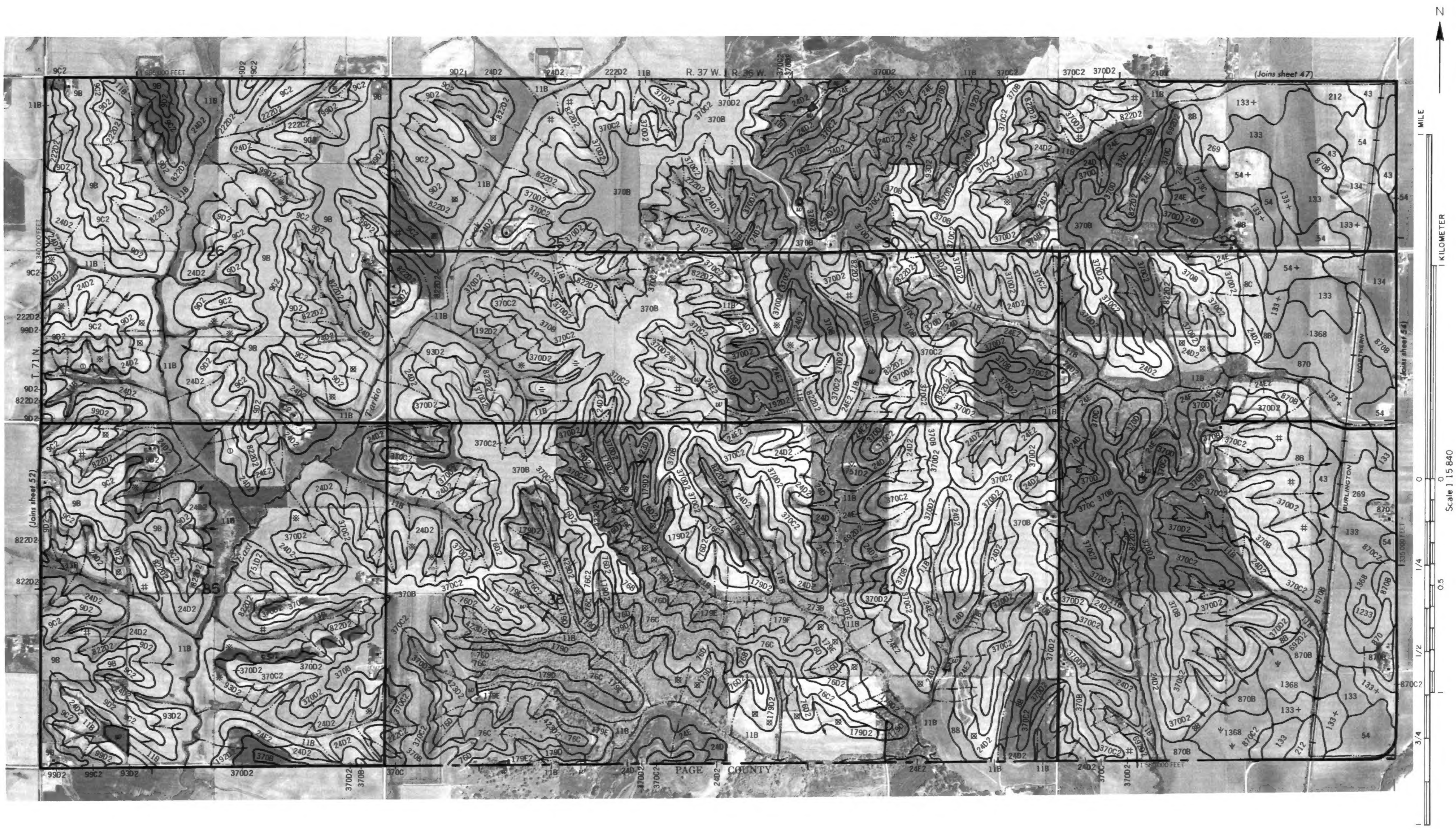
N



MONTGOMERY COUNTY, IOWA NO. 51

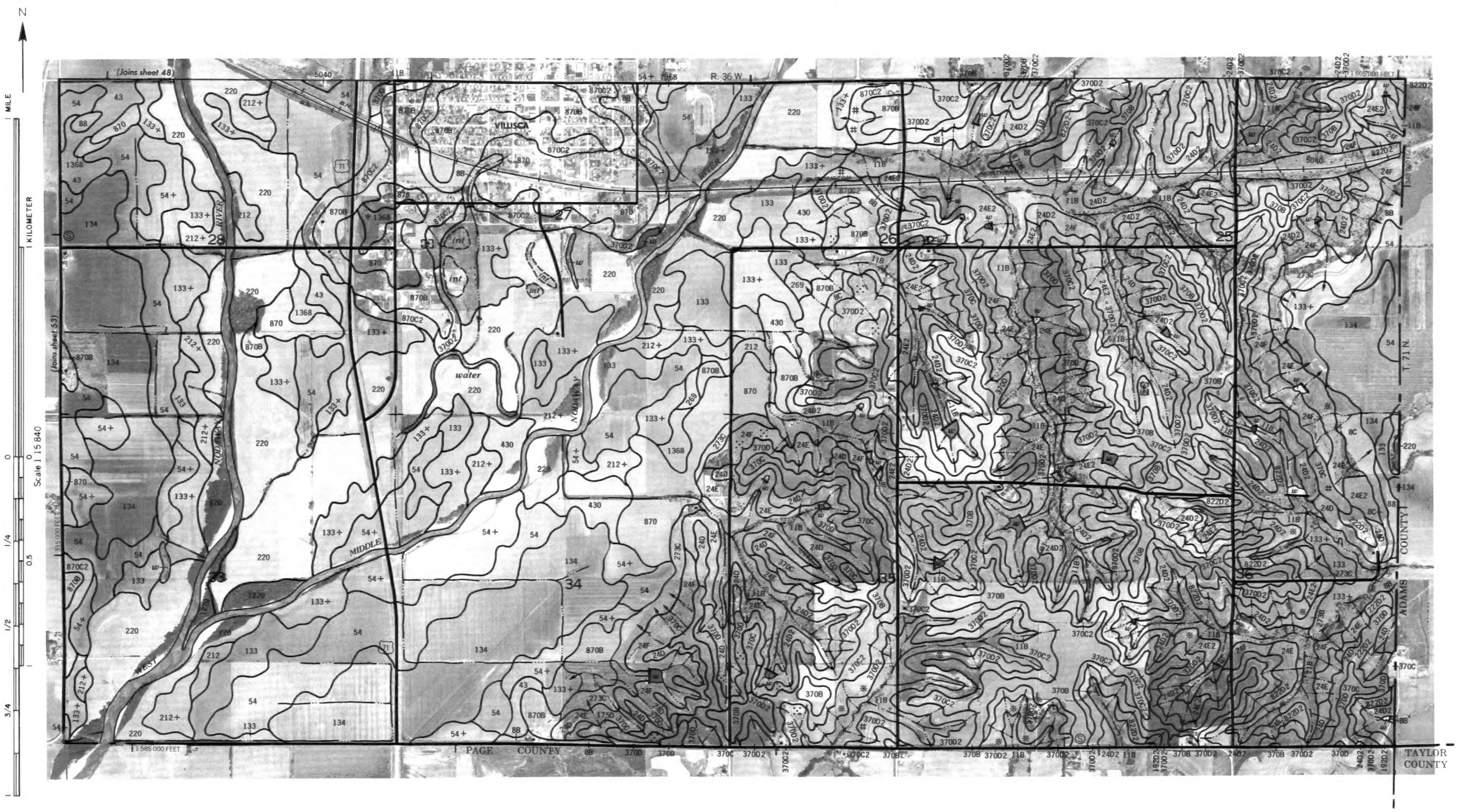

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
1
R. 37 W.
(Joins sheet 46)
(Joins sheet 51)
(Joins sheet 53)
River
Tarkio
PAGE COUNTY
29
28
30
32
33
34
71 N.
1 560 000 FEET
340 000 FEET
335 000 FEET
1 545 000 FEET

53



MONTGOMERY COUNTY, IOWA NO. 53

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



MONTGOMERY COUNTY, IOWA NO. 54